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RAILWAY SHOPS.

By R. H. SOULE.

XIII.**THE LAYOUT.**

After deciding on the floor areas and general features of the several departments which are to be included in the plant, their relative arrangement and track connections (collectively termed "the layout") have to be considered. In a general repair plant there are two groups of buildings, for locomotive work and car work respectively, and often some buildings common to both. A single building may, and generally does, contain more than a single department, and the relations between the departments largely influence the grouping of the buildings. The principal departments of the locomotive group are the erecting shop, the machine shop, the boiler shop, the smith shop, and the storehouse. It is believed that under average conditions the amount of business interchanged between these five departments should justify favoring facility of intercommunication in the following order: (1) Erecting and machine; (2) erecting and boiler; (3) machine and smith; (4) boiler and smith; (5) machine and boiler; (6) erecting and smith; (7) machine and storehouse; erecting and storehouse; (9) boiler and storehouse; (10) smith

and storehouse. It is assumed that the stock of boiler plate, although under storehouse jurisdiction, is kept at or near the boiler shop, and, similarly, that the stock of bar iron is kept at or near the smith shop.

It seldom happens that the storehouse can be located equidistant from the locomotive group and the car group of buildings, and in the majority of plants the storehouse is made one of the locomotive group, it being felt that the best results can be obtained in that way. Therefore, with the storehouse eliminated from consideration, there remain, as the principal departments of the car plant, the passenger repair shop, the passenger paint shop, the cabinet shop, the upholstery shop, the freight repair shop (or yard) and the planing mill. The relative importance of the interchange of business between these six departments, as affecting their grouping may be taken to be about as follows: (1) Passenger repair and cabinet; (2) passenger repair and paint; (3) passenger repair and upholstery; (4) passenger paint and cabinet; (5) cabinet and upholstery; (6) passenger paint and upholstery; (7) freight repair and planing mill; (8) cabinet and planing mill; (9) passenger repair and planing mill; (10) passenger repair and freight repair; (11) passenger paint and freight repair; (12) cabinet and freight repair; (13) passenger paint and planing mill; (14) upholstery and freight repair; (15) upholstery and planing mill.

The following are some of the principal points to be borne in mind in connection with the general problem of the railway shop layout:

1. A longitudinal erecting shop is parallel to the base line of tracks, and does not require either a turntable, transfer table, or fan tail, for its approach.

2. A transverse erecting shop, if its stall tracks are to be parallel to the base line, must be approached either by a fan tail or by a transfer table.

3. A transverse erecting shop, if its stall tracks are to be at right angles to the base line, must be approached by a turntable.

4. Buildings should be so arranged that each may be extended by a large fraction of its original size. In the case of separate departments within the same building, permanent barriers between them should be avoided, so that the original assignment of space to each may be modified to suit altered conditions.

5. All buildings (or departments, or bays of buildings) which are to have traveling crane service, should, in order to get maximum results from the investment, be relatively long and narrow.

6. Each principal department should have yard room (which it can control) adjacent to it.

7. The track system should be so arranged that tracks between principal buildings should simply be running tracks, and not standing tracks on which strings of cars may be left.

8. Outside tracks should not be so close to buildings that cars left standing on them will block off the light from any portion of the interior of a building.

9. Avoid placing 8-ft. turntables (for hand trucks) in running tracks which are to be used by locomotives, and, whenever possible, place such turntables under travelling cranes, facilitating their removal when pits have to be cleaned out.

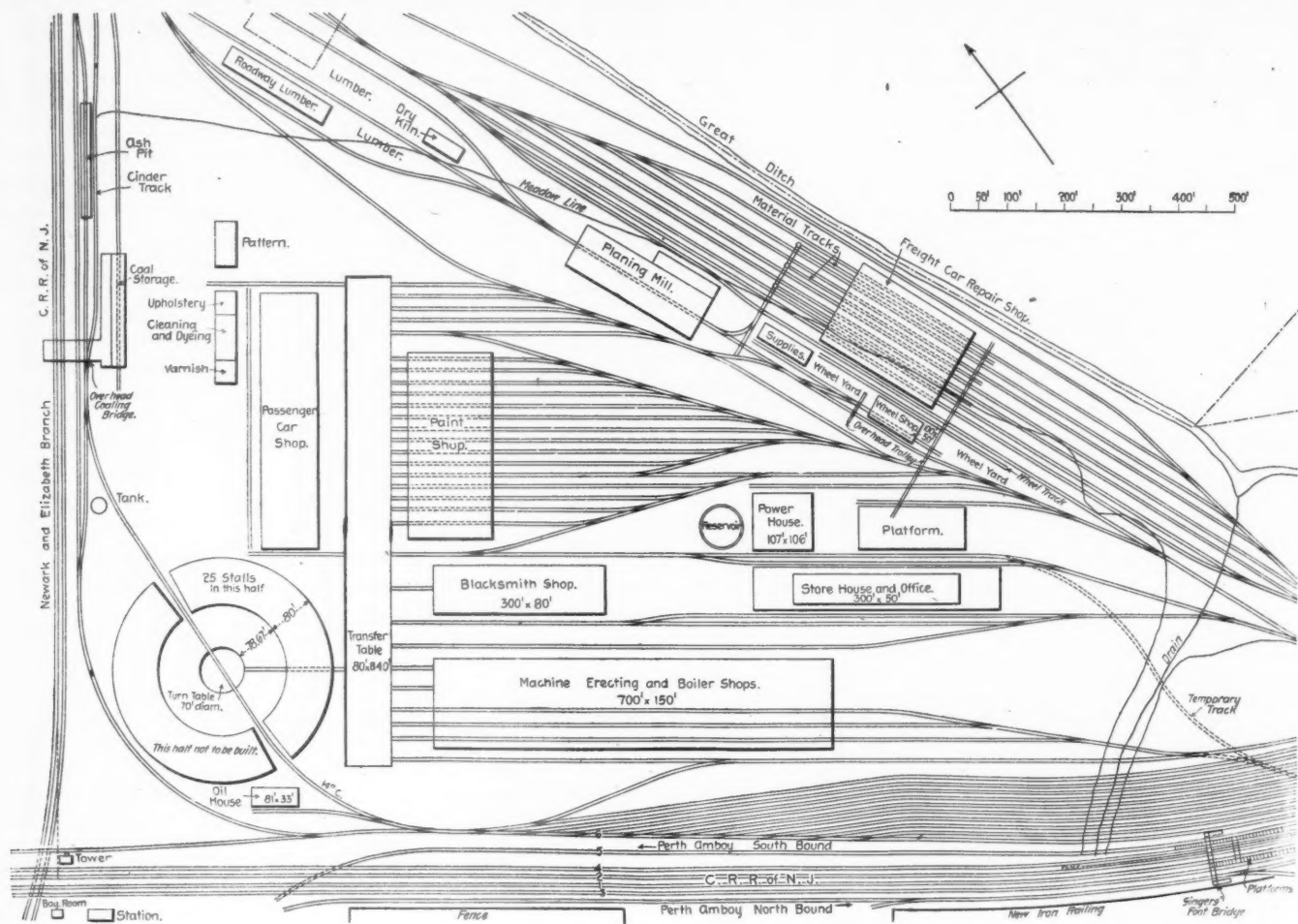
10. A yard crane should have a surface track parallel to and between runways, and connecting to tracks leading into buildings. Such a track will be very serviceable when the crane is either busy or out of service.

11. The roundhouse (if any) should be accessible from machine shop and boiler shop; accessibility from the smith shop is not so important.

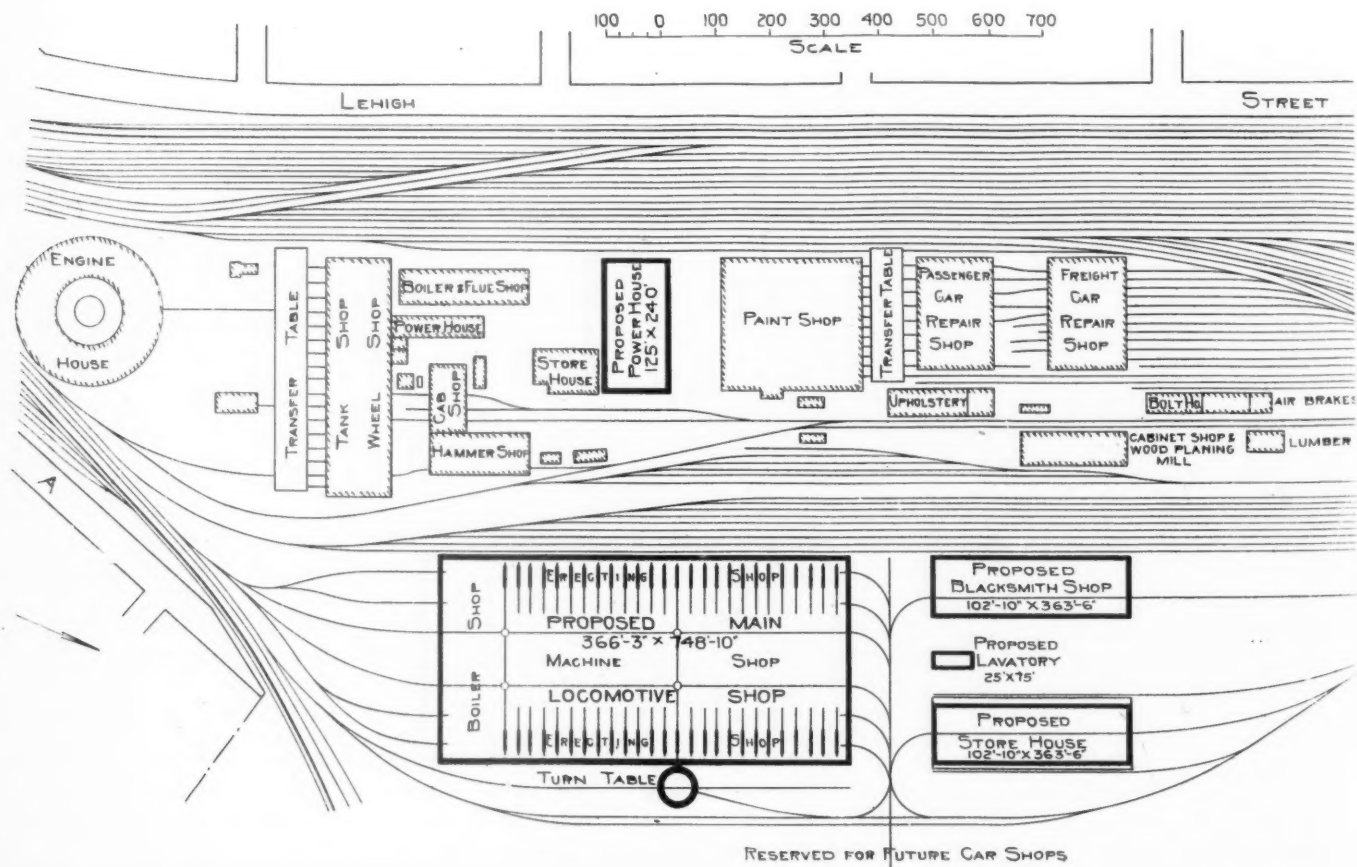
12. The oilhouse, when possible, should be between and easily accessible from the roundhouse and the storehouse.

13. If a transfer table is necessary (as it probably will be at the passenger car shop) it should preferably be located at one edge of the property so as to impede general yard traffic as little as possible.

14. If the shop group is in sight of the main passenger tracks, engines and cars awaiting repairs should be kept behind the buildings.



ELIZABETHPORT SHOPS, CENTRAL RAILROAD OF NEW JERSEY.



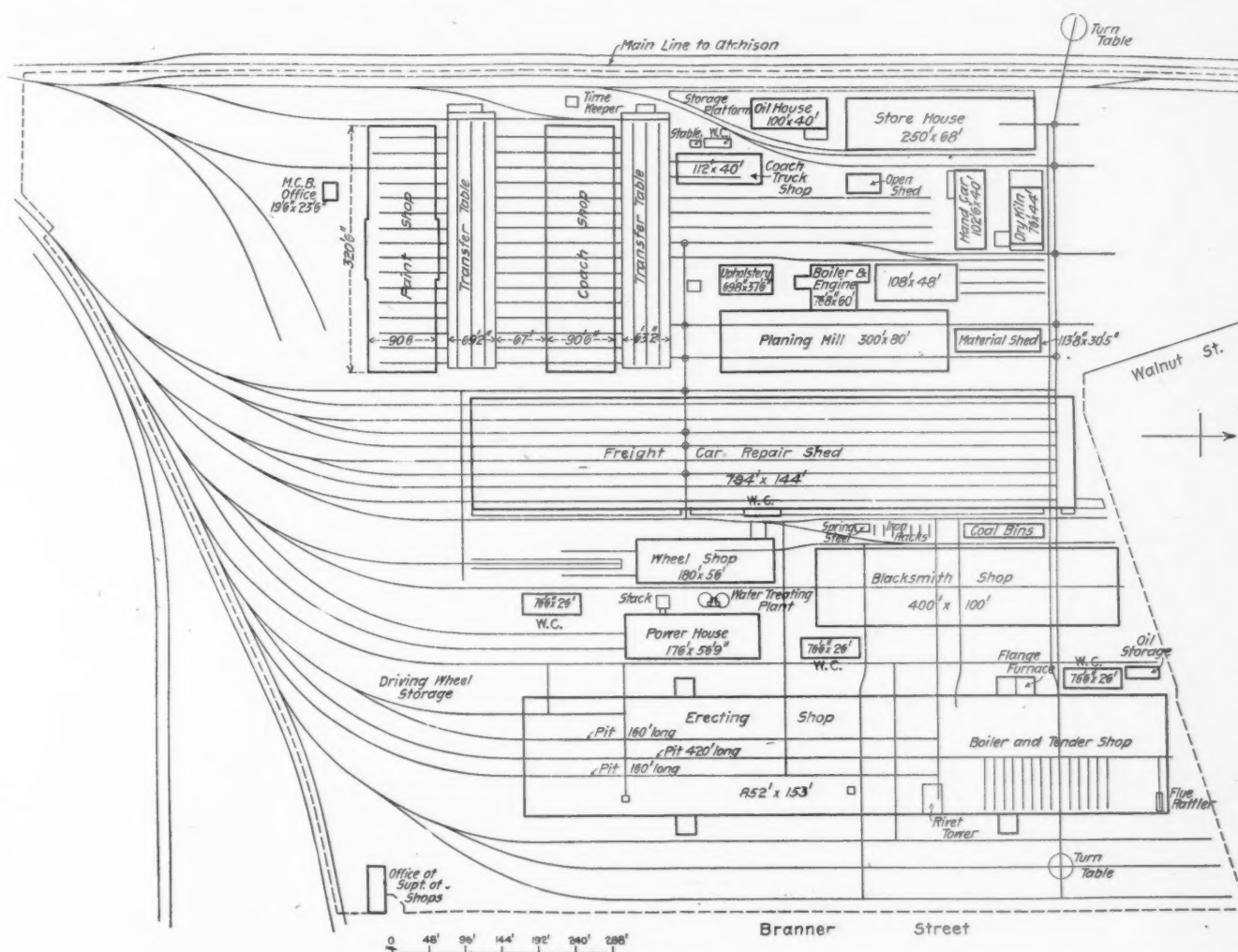
SAYRE SHOPS—LEHIGH VALLEY RAILROAD.

15. The original layout should include all yard accessories, such as scrap bins, lavatories, miscellaneous storage, lumber yard, etc.

16. The power plant should be central as regards power distribution, but should be isolated as a precaution against fire.

The relative merits of the longitudinal and the transverse erecting shop, considered from a construction and operating standpoint, have already been discussed, but the longitudinal shop lends itself more readily to the average layout conditions, and eliminates both the turntable and the transfer table (as regards the locomotive group of shops) from the problem, and these are generally realized to be obstacles in the way of simple and direct track connections. As regards the extensions of buildings it is well to group the original structures as near to one another as circumstances permit, and to re-

can usually be kept busy; practice tends towards keeping the scrap bins within easy reach of the smith shop, without, of course, sacrificing its relations to other departments from which it receives its principal contributions of scrap. Similarly, the smith shop foreman is often given a supervisory or advisory jurisdiction over the scrap platform, as being likely to be the best judge of what materials may be redeemed and used over (with or without having work done on them, as the case may be), what may be worked up into heavy forgings in the smith shop, and finally, what should be listed and reported for sale. If there is a traveling crane in the yard an effort should be made to so locate it or so locate the scrap bins as to make the crane of service in handling scrap; it is especially useful in unloading tangled wreckage as it comes in off the road, and may also be availed of in loading scrap for shipment, if certain other minor facilities are provided.



TOPEKA SHOPS—ATCHISON, TOPEKA & SANTA FE RAILWAY.

serve space for their extension outwardly from the general centre. The best evidence that transfer tables are apt to be an obstruction to traffic is that in several cases they have been installed and subsequently removed, as, for instance, at the New Haven, Conn., car shops of the N. Y., N. H. & H., and at the Juniata, Altoona, Pa., locomotive construction shops of the Pennsylvania Railroad.

Scrap bins have too often been left to chance and have been wedged in in cramped quarters after the buildings were completed and the plant put in operation; but discussion in the railway clubs and elsewhere during the last five years has focused attention on the problem and led to a better state of affairs, so that in some few cases (Collinwood, for instance,) the scrap storing, handling, and shipping facilities have been made part of the general scheme from the beginning, and installations worthy of the importance of this branch of current business have been put in. A power shear is a very useful adjunct, and machines for straightening bolts and rethreading them

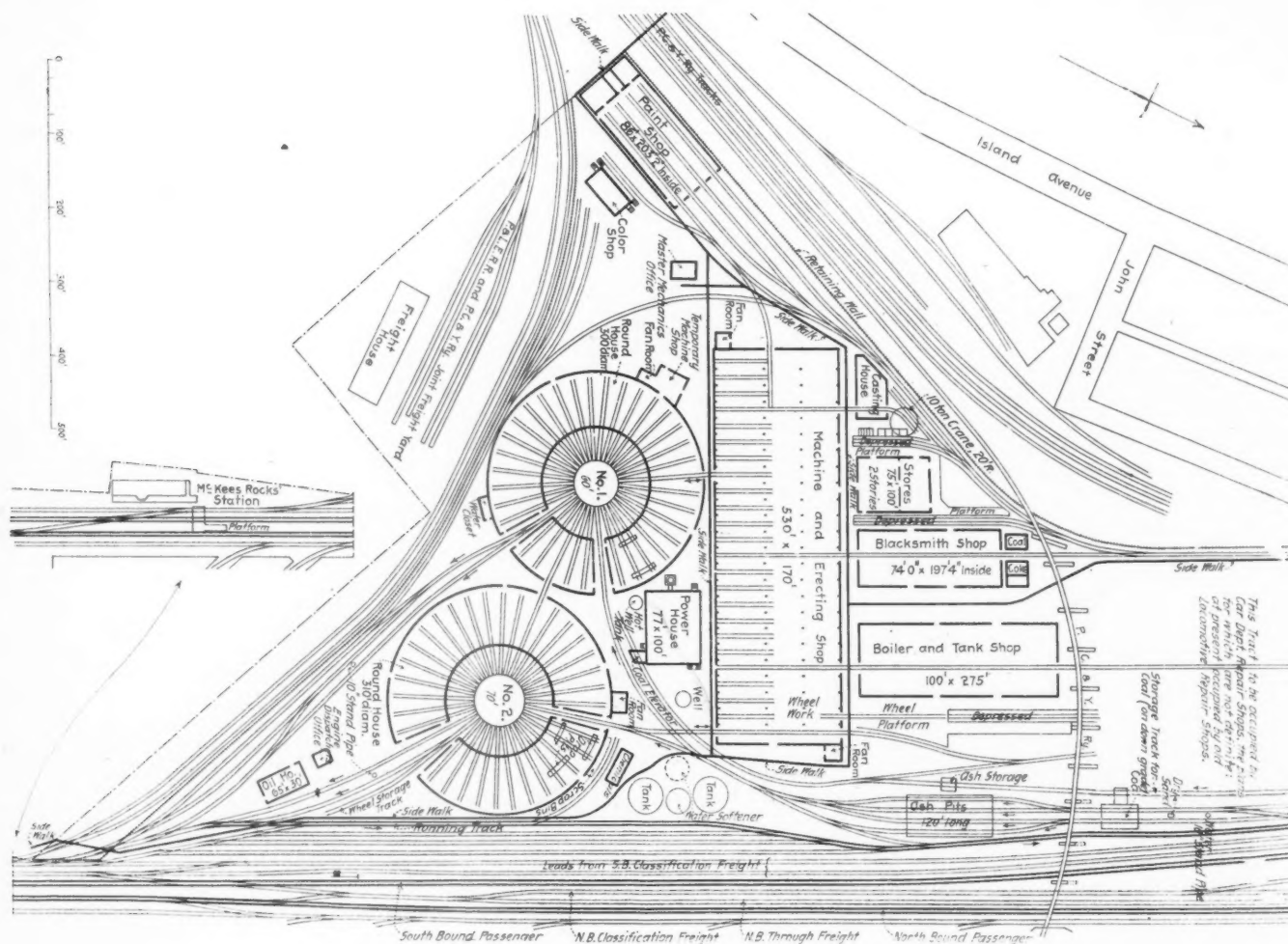
Opinion seems to be divided on the question whether water closet facilities can be maintained inside of shop buildings without becoming a nuisance, but as lavatories can be and urinals should be inside, the closets are often placed inside with them to secure concentration. The room containing these facilities should have independent ventilation to the outside atmosphere without any possibility of escape to the inside of the buildings, and this end is sometimes secured most readily by placing these accommodations on a gallery, or, as has been done in some cases, placing the lavatory and the urinals on the ground floor for convenient access, and the closets on a second floor over them, and open to the roof. If these accommodations are not to be inside the main buildings, they then become a part of the layout problem, and may be made one-story structures located as centrally as possible without forming obstructions to building extensions. On low riparian lands, where sewerage conditions are not favorable, water closets are often provided with a crematory feature.

In the course of time there will naturally gravitate to every large shop for storage a lot of old apparatus (machine tools, etc.), having some potential value, but for which no immediate use can be found. This accumulation can seldom be cared for in the regular storehouse, and is worthy of some special and separate provision, which ordinarily may be limited to an enclosed shed with a track running through it longitudinally along one side, a floor raised a few inches above ground level, and an overhead crane, of perhaps $2\frac{1}{2}$ tons capacity, covering both track and floor and having sufficient headroom to permit the passage of box cars under it. As such a crane would be use only occasionally, it would not pay to have it electrically driven, but a hand crane would be sufficient. Such a storage shed, while well worthy of being considered and provided for in the original layout, may nevertheless be isolated from the other buildings and placed in any available spot.

tables located under the yard crane, while there are several more which are not covered by the yard crane. At this plant the drainage conditions are exceptionally favorable, and inasmuch as the snow fall is maximum, the practical results which may be realized from the use of this installation may be appealed to with confidence.

Layout plans of Elizabethport, N. J. (C. R. R. of N. J.), Sayre, Pa. (L. V.), Topeka, Kan. (A. T. & St. F.), and McKees Rocks, Pa. (P. & L. E.) are submitted herewith, as a basis of comment. Longitudinal erecting shops are used at Elizabethport and Topeka, transverse erecting shops at Sayre and McKees Rocks. Elizabethport and McKees Rocks are new plants throughout; Sayre and Topeka are each a combination of old shops and new shops.

Elizabethport presented a peculiar problem, as the available land took the shape of a right angled triangle. As the



MC KEES ROCKS SHOPS—PITTSBURGH & LAKE ERIE RAILROAD.

The use of 8-ft. turntables outside of buildings is objected to by many and for various reasons: First and most important, because they must be excluded from all tracks over which locomotives are likely to pass, and, second, because their pits are likely to at times fill up with dirt, or be frozen up, and the turntables thus become inoperative. On the other hand, they permit of much more direct truck track connections than any system of switches possibly can, and trucks will make better time over them than over switch connections, as in the latter case the truck must be left while the switch is being turned in more than half the movements. Further, if the pit masonry is good and heavy, carried well below the frost line, and the pit provided with ample drainage, the time the turntable will be out of service will be a very small fraction of working hours, if any. Those 8-ft. turntables, which are under a yard crane, are easily lifted out when there is work to be done in the pits, and at the new Montreal, Can., Angus shop plant of the Canadian Pacific, there are 17, 8-ft. turn-

roundhouse was to serve both the main line and the two diverging branches (only one being shown in the plan) the rectangular corner of the property was naturally the preferred location for it, and this fixed the oilhouse as adjacent to it. The erecting and machine shops were obviously to be kept as close as possible to the roundhouse, as in this case the roundhouse has no machine shop annex of its own. Other considerations suggested that the transfer table be interposed between the roundhouse and the main shop, but this somewhat hinders foot traffic between the two, and also leaves the boiler shop, which always has very intimate relations with the roundhouse, rather far away from it. The smith shop falls into place nicely as regards the main shop building, and has very good connections with the passenger shop, freight shop, and storehouse. The storehouse is somewhat out of the centre of gravity, but has good track connections and shipping facilities; the power house is centrally located as regards power consumption; the transfer table pit is one of the largest in

the country, others are longer and narrower, but none has a greater ground area. The passenger car buildings are naturally grouped about the transfer table, the cabinet shop, for convenience, being located in one end of the passenger repair shop, rather than at the more remote planing mill. The paint shop stall tracks are reached from the transfer table only, the yard tracks on the opposite side of the building not running into it. The freight repair facilities include a building and have the planing mill close at hand, the cabinet shop being elsewhere, as is also the case at the new shops of the Pennsylvania at Wilmington, Del. It can be said of Elizabethport that it is possible to extend each individual building in a large ratio.

Sayre was a problem where a very large increase of locomotive repair facilities was imperative. Efforts were made to provide additional structures within the limits of the original shop property, but, as this proved to be impossible without undue congestion and forbidding all future extensions, additional and adjacent property was acquired. Four new buildings house the erecting shop, machine shop, boiler shop, smith shop, storehouse, and power plant, and the work still remaining in the old buildings had to be redistributed. The new main building has track connections into each of its several crane served bays from both ends of the building; those at one end can evidently be used either by locomotives or by hand trucks; those at the other end by hand trucks only. The two erecting shops being of the transverse type, with the long side of the building placed parallel to the track base line, access by turntable was necessary, and the engines after being taken in are lifted over one another to be placed in the repair stalls. The use of 8-ft. turntables outside of buildings has been avoided, and a system of curves and switches substituted by which hand trucks may pass between the three buildings and the six bays of the main building; the storehouse being over 100 ft. wide, the central through-track will be very serviceable in the way of placing road cars in the centre of the floor space for loading and unloading, and not less so in making it possible to run hand trucks in from the shop side as well. It will be noticed that a large lavatory building is to be provided in a space between buildings, but it is not known whether other lavatories are to be provided inside some of the buildings as well.

Topeka was also a problem of enlargement, the available land being across the main tracks from the original shop location. On account of the peculiar shape of the property, the several longitudinal buildings have track connections from one end only, and in order to avoid the necessity of keeping the centre track of the erecting shop always open through to the boiler and tender shop, a turntable is introduced by means of which tenders may be brought into the boiler and tender shop direct, and it naturally follows that the tenders or their frames or tanks when lifted into working position

are stood transversely to the length of the building. The exigencies of the particular case made it necessary to have the power house long and narrow instead of the more prevalent type of a building nearly square, which is usually preferred, where possible, as it minimizes pipe connections and presents some other advantages. The smith shop, while favorably located in reference to those other departments which it principally serves, apparently cannot be extended. It will be noticed that the wheel shop has a depressed track adjacent to it to facilitate loading and unloading mounted wheels. The freight car repair shed is a fine example of liberal provision for this class of work, and it covers nearly the whole of the freight repair yard. In the passenger car group of buildings the unusual feature is the use of two transfer tables where one would seem to have answered for the coach shop and paint shop, but possibly the second one is intended to give access to the planing mill, the coach truck shop, and the intermediate yard tracks. Owing to the peculiar conditions of this layout, several cross connecting tracks are required, and it is understood that some of them are provided with pneumatic jack turntables at crossings, which cause no break (other than frogs) in the track rails.

McKees Rocks is a very interesting layout in many particulars. The first thing that attracts attention is that the roundhouse accommodations are unusually liberal in proportion to the size of the shop; next it is observed that the entire available property is occupied from the outset, there being no chance for the expansion of any building in any direction. This probably results from the fact that level tracts of land are very scarce at or near Pittsburgh (McKees Rocks being only four miles out) which traffic conditions fix as the natural and preferred shop location. To secure the results aimed at, the distance between the main building is reduced to 25 ft. in several instances, while in a few instances it is even less than that. This ought to be taken as a valuable precedent, as it is always advisable to keep shop buildings as close together as possible, and with modern steel and brick construction and improved fire precautions it is certainly practicable to relax somewhat from the rigid conditions imposed by insurance companies in the days when wood was more largely used in building construction and the modern concentrated shop power plant had not been evolved, the latter being almost always equipped with large and powerful underwriters fire pumps, with steam up and skilled attendants on hand at all times. Other noticeable features are that each roundhouse has two sets of approach tracks, that the ash pits cover four tracks, that the oilhouse is located with reference to the roundhouse rather than the storehouse, that there are three depressed tracks, (one for handling mounted wheels and two alongside of the storehouse) and that the passenger car paint shop is of the longitudinal type.

(To be continued.)

WATER PURIFICATION—Practical experience has shown that the use of soft water has greatly reduced the amount of boiler repairs. It is an established fact that boilers using soft water give very little trouble from leaky flues. A superintendent of motive power has stated that since the installation of 17 water-softening plants on a busy division of his road, 12 boiler-makers are now required to keep up the boiler repairs where 23 were needed before the plants were installed. The chief engineer of another railroad that has 10 water-softening plants in operation on one division has stated that these plants are removing 2,790 lbs. of incrusting solids from the water per day, and that the saving in boiler repairs alone warrants the expenditure of the amount necessary to treat the waters. Another railroad has recently completed new repair shops that are strictly modern in every respect. In designing the boiler shop the floor space was made considerably less than the average for repair shops of similar capacity. This road has installed 10 water-softening plants, and has found from practical experience with them that the repairs to boilers were so much decreased that it would not be necessary, in order to keep up their boilers, to build a boiler shop of the usual capacity.—*Report to American Railway Engineering and Maintenance of Way Association.*

Mr. Thomas Roope, heretofore superintendent of motive power of the Atchison Topeka & Santa Fe Railway at Topeka, Kansas, has been appointed superintendent of motive power of the Western lines with headquarters at the same place.

Mr. T. N. Gilmore, heretofore master mechanic of the Terminal Railroad Association of St. Louis, has been appointed assistant to the general superintendent of motive power of the Chicago, Rock Island & Pacific Railway, with headquarters in Chicago.

Mr. N. M. Boyden has been appointed master mechanic of the Southern Railway with headquarters at Selma, Ala. He is promoted from the position of foreman of locomotive repairs.

TWO HUNDRED AND THIRTY MILES WITHOUT A STOP.—In connection with the mail service from the United States, the London & Southwestern Railway is preparing to run trains from Plymouth to London, 230 miles, without an intermediate stop. The time of the train is to be 4½ hours, the rate being 51 miles per hour.

COLE'S 4-CYLINDER BALANCED COMPOUND LOCOMOTIVE.

NEW YORK CENTRAL & HUDSON RIVER RAILROAD.

4-4-2 TYPE.

Through the courtesy of Mr. J. F. Deems, general superintendent of motive power, and the American Locomotive Company, this remarkably interesting locomotive is illustrated by a photograph and a more extended description will follow.

This locomotive represents a careful effort to provide as many of the essential elements of the famous De Glehn four-cylinder compound as appeared to the designer advisable to introduce into an American locomotive design at this time. The important elements are four cylinders for compound working, so arranged that their forces, which constitute a disturbing element in the ordinary construction of locomotives, oppose and neutralize each other to produce a balanced engine. The work is divided among four cylinders in such a way that each part has less duty to perform than in the usual construction, and furthermore this engine is arranged to divide the cylinder stresses between two driving axles, instead of concentrating them all upon the crank axle. It seems fitting to remark that this is one of the most promising locomotive designs for American conditions and readers of this journal are urged to watch this development with the greatest care.

In accordance with the position this journal has taken in advocating thorough trials of the principles of the four-cylinder compound and the division and balancing of the cylinder effects Mr. Cole's design is illustrated with pleasure and even gratification. Its appearance marks further evidence of faith in the principles so successfully applied in the De Glehn compounds in Europe. Mr. Cole's design employs but one valve motion on each side of the engine and thus stops short of De Glehn's complete idea. The advent of a balanced and divided compound by the American Locomotive Company together with the ready acceptance of 4-cylinder balanced compounds built by the Baldwin Locomotive Works, certainly seems significant of a new era in American locomotive design.

In this journal for April, 1903, page 145, Mr. Cole's arrangement of cylinders was described and we shall present the details of construction and a description of the design in our next issue. This locomotive will form part of the exhibit of the New York Central Railroad at St. Louis. The leading dimensions are given in the following table:

FOUR-CYLINDER BALANCED COMPOUND LOCOMOTIVE. COLE SYSTEM.

NEW YORK CENTRAL & HUDSON RIVER RAILROAD.

GENERAL DIMENSIONS.

Gauge	4 ft. 8½ ins.
Fuel	Bituminous coal
Weight in working order	200,000 lbs.
Weight on drivers	110,000 lbs.
Weight engine and tender in working order	321,600 lbs.
Wheel base, driving	7 ft.
Wheel base, rigid	16 ft. 6 ins.
Wheel base, total	27 ft. 9 ins.
Wheel base, total, engine and tender	53 ft. 8 ins.

CYLINDERS.

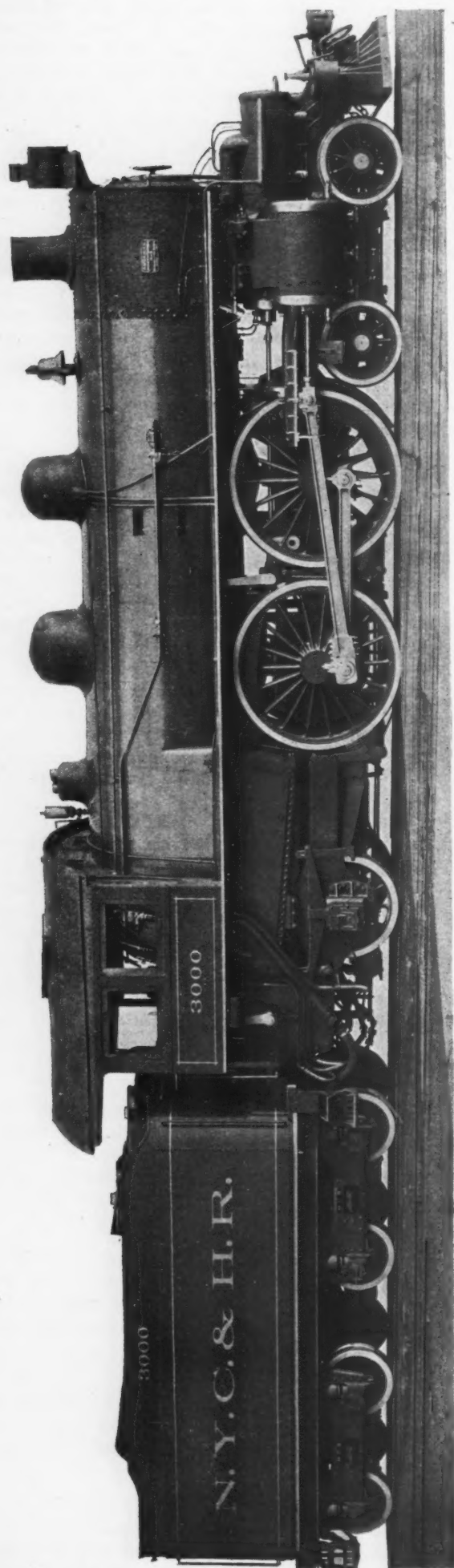
Diameter of cylinders	15½ ins. and 26 ins.
Stroke of piston	26 ins.
Horizontal thickness of piston:	
Low pressure, outside, 5¼ ins.; high pressure, inside, 6¼ ins.	
Diameter of piston rod	3 ins.
Kind of piston packing	Cast-iron rings
Kind of piston-rod packing	U. S. metallic, with Gibbs vibrating cup

VALVES.

Kind of slide valves	Piston type
Greatest travel of slide valves	6 ins.
Outside lap of slide valves	1 in.
Inside clear of slide valves	High pressure, ¼ in.; low pressure, ⅜ in.
Lead of valves in full gear:	
¼-in. lead forward motion when cutting off at 11 ins. of the stroke	
Kind of valve-stem packing	U. S. metallic

WHEELS, ETC.

Number of driving wheels	4
Diameter of driving wheels outside of tire	79 ins.
Material of driving-wheel centers	Cast steel
Thickness of tire	3½ ins.
Driving box material	Cast steel
Diameter and length of driving journals	10 ins. diameter x 12 ins.
Diameter and length of main crankpin journals:	
(Back side, 6¼ x 4 ins.) Back, 6 ins. diameter x 6 ins.	
Diameter and length of side-rod crankpin journals:	
Front, 5 ins. diameter x 3¼ ins.	
Engine truck, kind	Four-wheel
swing cen. bear, spring centering device railroad company style	



FOUR-CYLINDER, BALANCED, DIVIDED COMPOUND LOCOMOTIVE—4-4-2 TYPE.—NEW YORK CENTRAL & HUDSON RIVER RAILROAD.
AMERICAN LOCOMOTIVE COMPANY, SCHENECTADY WORKS, BUILDERS.
J. F. DEEMS, General Superintendent Motive Power.

Engine-truck journals	6½ ins. diameter x 12 ins.
Diameter of engine-truck wheels.....	36 ins.
Kind of engine-truck wheels.....	Krupp No. 3 cast-iron spoke, 3¼ ins.
Trailing truck rigid, with outside journals.....	8 x 14 ins.
Trailing-truck wheels, diameter	50 ins.

BOILER.

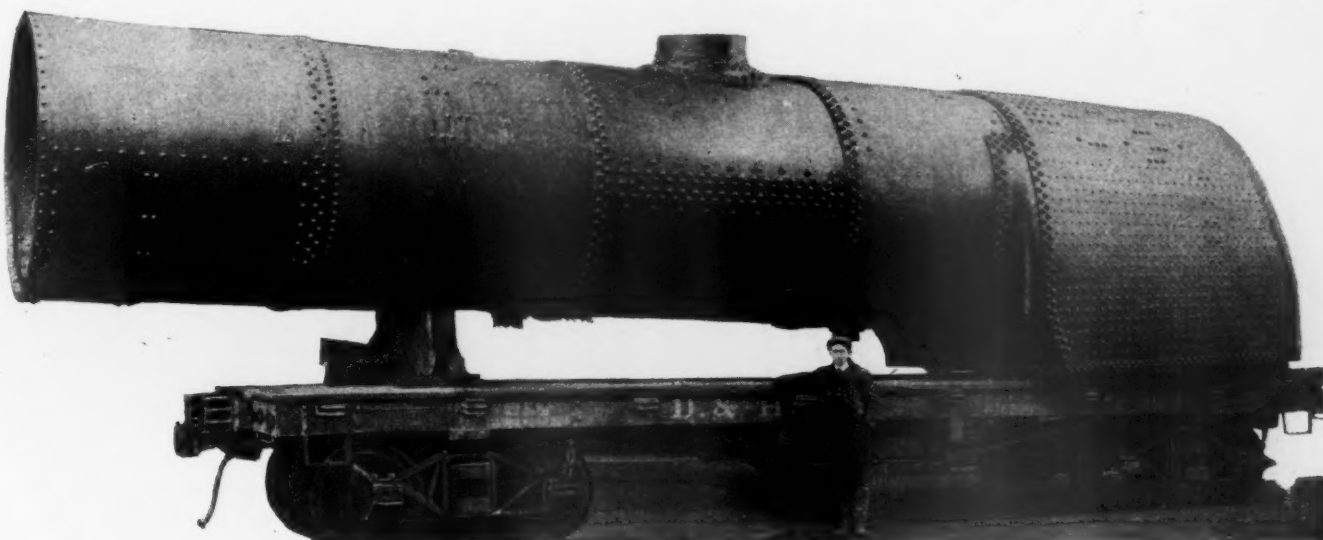
Style	Straight top, radial stay
Outside diameter of first ring.....	72¼ ins.
Working pressure	220 lbs.
Material of barrel and outside of firebox.....	Coatsville (Worth Bros.) steel
Thickness of plates in barrel and outside of firebox.....	13-16, 9-16, ¾ in.
Firebox, length	96½ ins.
Firebox, width	75¼ ins.
Firebox, depth.....	Front, 80¼ ins.; back, 63 ins.
Firebox, material	Carbon steel
Firebox plates, thickness:	
Sides, ¾ in.; back, ¾ in.; crown, ¾ in.; tube sheet, ½ in.	
Firebox, water space:	
Front, 4 and 5 ins.; sides, 3½ and 5½ ins.; back, 3½ and 4½ ins.	
Firebox, crown staying	Radial
Firebox, staybolts	Taylor iron 1 in. diameter U. S.
Tubes, number	390
Tubes, diameter	2 ins.
Tubes, length over tube sheets.....	16 ft.
Fire brick, supported on.....	Water tubes
Heating surface, tubes	3,248.1 sq. ft.
Heating surface, water tubes	23 sq. ft.
Heating surface, firebox	175 sq. ft.
Heating surface, total	3,446.1 sq. ft.
Grate surface	50.3 sq. ft.
Exhaust nozzles	5½ ins., 5½ ins., 5½ ins. diameter
Smokestack, inside diameter	18 ins.
Smokestack, top above rail	14 ft. 8 ins.

TENDER.

Weight, empty	51,600 lbs.
Wheels, number	8
Wheels, diameter	36 ins.
Journals, diameter and length.....	5½ ins. diameter x 10 ins.
Wheel base	16 ft. 9½ ins.
Tender frame	10-in. channels
Tender trucks	Fox pressed-steel frames and bolsters
Water capacity	6,000 U. S. gals.
Coal capacity	10 tons

of 70,000 lbs. when running as a compound. Many points of interest in the design must be left for further consideration in another article. This locomotive is believed to be the most interesting and significant development in the construction of very heavy units and a careful study leads to the conclusion that it must be successful in principle, the only uncertainties being in minor details. It is well that the Mallet type should be tried in this country and the boldness of Mr. Muhlfeld and the builders in attacking the problem on so large a scale is to be commended. It is believed that if this locomotive is successful, and there is every reason to believe it will be, it will mark an important step in the further development of the very large freight locomotive.

This boiler weighs 117,000 lbs. with water, but without the exterior fittings. The weight of the water alone is 33,000 lbs. and that of the tubes 27,000 lbs., the weight of the shell and fire-box without tubes being 57,000 lbs. The shell plates are 1 in. thick, the roof sheet ¾ in., the front tube sheet ¾ in., the back head ¾ in. and the throat sheet 1 in. The horizontal seams are butt jointed, sextuple riveted, with 1¼-in. rivets, the joints being designed for 70 per cent efficiency. The circumferential seams are double riveted with 1¼ in. rivets, the joints having an efficiency of 50 per cent. The working pressure is to be 235 lbs. per sq. in. The fire-box is 108 in. long by 96 in. wide; 80 in. deep at the front end and 72 in. at the back end. The fire-box plates are of the following thickness: sides ¾ in., crown 7-16 in., tube sheet ½ in., door sheet ¾ in.



THE LARGEST LOCOMOTIVE BOILER IN THE WORLD. BUILT BY THE AMERICAN LOCOMOTIVE COMPANY.

MALLET COMPOUND LOCOMOTIVE, BALTIMORE & OHIO RAILROAD.

THE LARGEST OF LOCOMOTIVE BOILERS.

FOR MALLET COMPOUND LOCOMOTIVE—BALTIMORE & OHIO R. R.

This photograph illustrates the enormous boiler of the compound locomotive of the Mallet type which is being built by the American Locomotive Company at Schenectady for the Baltimore & Ohio Railroad. It is the largest boiler ever constructed for a locomotive, and because of the interesting character of the design a number of the details of construction will be presented in this journal when the work is finished.

In many ways this is the most remarkable locomotive ever constructed. Its total weight will be over 300,000 lbs., all of which is on the driving wheels. It will replace two heavy consolidation locomotives in pushing service over a hilly and very crooked track. It is built on the principle that where the grades are heavy the shortest wheel base is required and also embodies the principle of dividing the stresses produced in furnishing a draw-bar pull of 85,000 lbs. (in starting) among double the number of parts of running gear which have heretofore been applied in the construction of very large American locomotives. This engine is expected to exert a tractive effort

The mud ring is 6 in. wide in front and 5 in. wide at the sides and back.

This boiler provides 5,372 sq. ft. of heating surface in the tubes; 219 sq. ft. in the firebox, making a total of 5,591 sq. ft., which is 201 more square feet than the heating surface of the big Santa Fe locomotives illustrated in this journal in June, 1902, page 192. The Baltimore & Ohio boiler has 72.25 sq. ft. of grate area. It is 38 ft. 5 in. long from the front to the firebox door, and the diameter at the third ring is 88 in. Its enormous size is appreciated from the figure of the man standing beside it.

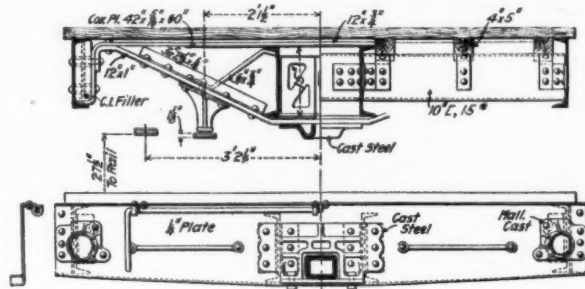
This photograph and information are presented through the courtesy of Mr. J. E. Muhlfeld, General Superintendent Motive Power, Baltimore & Ohio Railroad. The locomotive will be tested on the grades where it is to work on the Baltimore & Ohio, and will then be sent to the St. Louis Exposition to form part of the exhibit of that road.

John Reilly, president of the United States Metallic Packing Company died April 19, at the age of 69 years. He was connected with the Pennsylvania Railroad for thirty-one years and had been at the head of the United States Metallic Packing Company for fifteen years. He was held in high esteem by his associates, subordinates and friends.

100,000-POUND STEEL UNDERFRAME FLAT CAR.

The Standard Steel Works of Philadelphia have received a 40-ft. steel underframe flat car of 50 tons capacity from the Middletown Car Works, Middletown, Pa., built to the design of Mr. Geo. I. King, vice-president and general manager of the car works.

The underframe is in general similar in construction to that used by this company in other cars of this and also the box type. It has the unusual feature of truss rods, three in number, which, as shown in the engravings, extend from bolster to bol-



CROSS-SECTION AND END ELEVATION.

ster, as shown in the plan. All of these truss rods are near the center of the car, one of them being immediately under the center line. The car has the following general dimensions:

Length over end sills.....	40 ft.
Center to center of trucks.....	30 ft.
Width over side sills.....	9 ft. 1 1/2 ins.
Width over flooring.....	9 ft. 5 ins.
Height from top of rail to top of floor.....	4 ft. 2 1/4 ins.
Wheel face of truck.....	5 ft. 6 ins.
Weight.....	37,840 lbs.

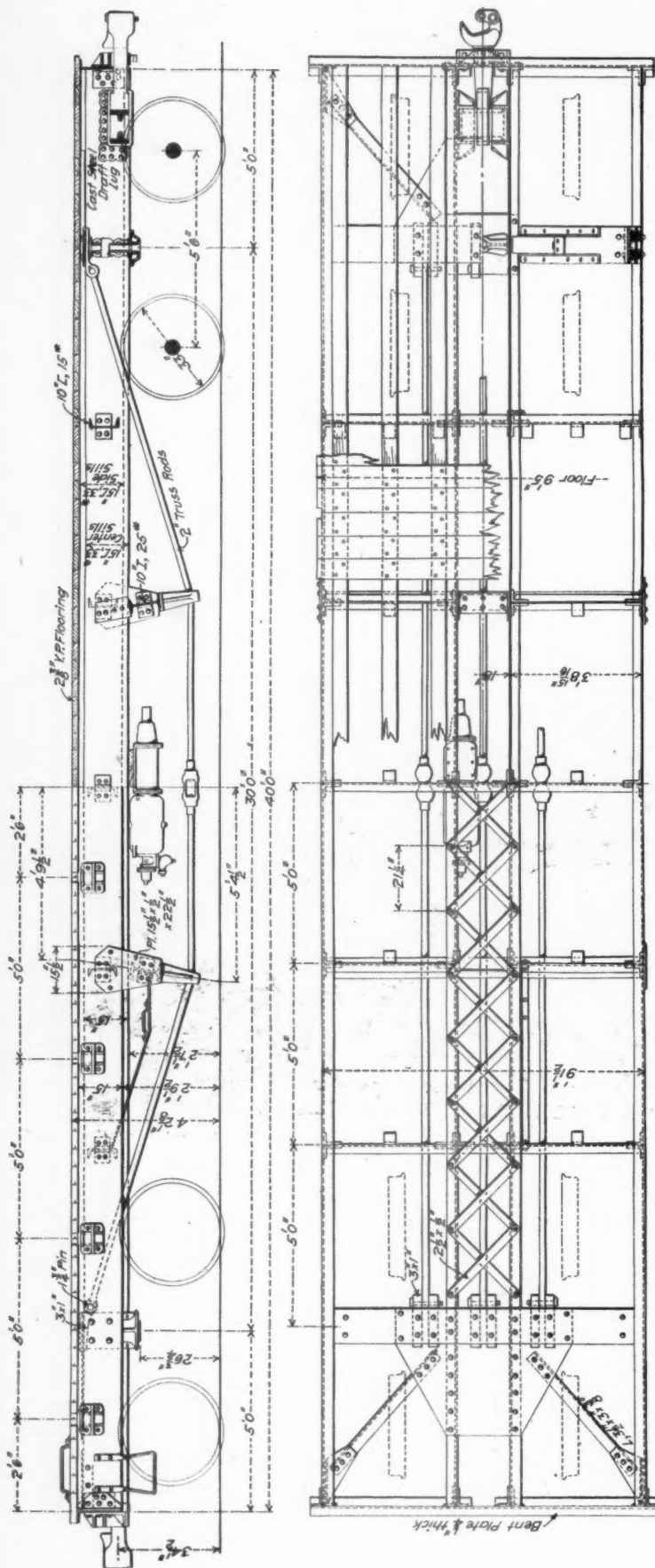
The center sills are 15 ins., 33 lbs. channels with the flanges turned outward. The side sills are 15 ins., 33 lbs. channels with the flanges turned inward. The bolsters are 1 by 12-in. plates for the lower members, and 3/4 by 12-in. plates for the upper members. These have large gusset plates extending over the center sills towards the ends of the car, and to them are secured the corner bracing angles. The end sills are of bent plate, 1/4 in. thick. The needle beams are 10-in. 25-lb. I-beams.

The idea in supplying this car with 2-in. truss rods is to permit of constructing the car to withstand compression and pulling stresses, as a column, and yet without making the center sills sufficiently heavy to withstand heavy service shocks without support. The truss rods are used to secure the necessary strength, and yet permit of employing relatively light center sills. The drawings show the location of the six 4 by 5 in. nailing strips for the flooring.

Mr. A. E. Mitchell has resigned as superintendent of motive power of the Northern Pacific Railway to succeed Mr. H. D. Taylor, as superintendent of motive power of the Lehigh Valley. Mr. Mitchell is a graduate of the Maine State College and began his experience as an apprentice at the Baldwin Locomotive Works. His first railroad service was in the test department of the Pennsylvania Railroad in 1877. He has had manufacturing experience, has been signal engineer of the New York, Lake Erie & Western, mechanical engineer of the Chicago & Erie and in 1892 was made superintendent of motive power of the Erie. Three years ago he went to the Chicago, Milwaukee & St. Paul as assistant superintendent of motive power and two years ago took charge of the motive power department of the Northern Pacific.

Mr. H. D. Taylor has resigned as superintendent of motive power of the Lehigh Valley Railroad.

MISSOURI PACIFIC NEW SHOPS—It is announced that the new main shops of this road, which will cost about \$1,000,000, will be located at Sedalia, Mo.



PLAN AND SIDE ELEVATION OF FIFTY-TON FLAT CAR WITH STEEL UNDERFRAME AND TRUSS RODS.

BUILT BY THE MIDDLETOWN CAR WORKS

NEW LOCOMOTIVE AND CAR SHOPS.

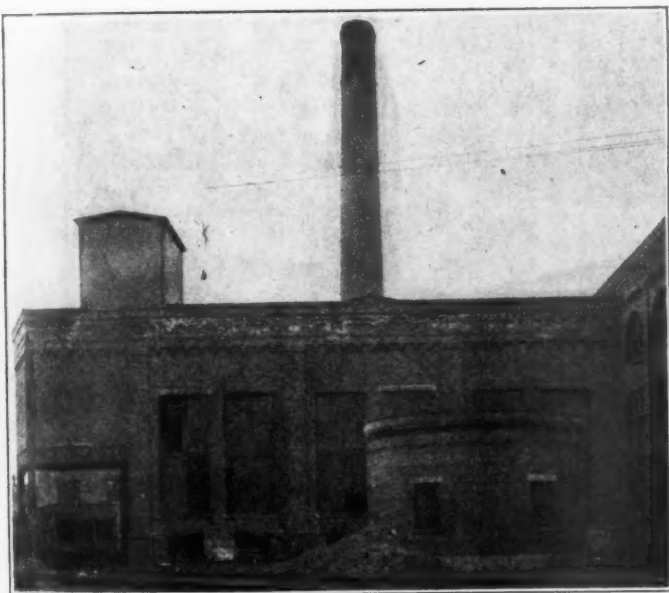
McKEES ROCKS, PA.

PITTSBURG & LAKE ERIE RAILROAD.

V.

THE POWER PLANT.

The power plant is the heart of the shop installation at McKees Rocks. In it is generated all power that is used in the shops, whether in the form of compressed air, steam for the hammers, or electricity for the motors and electric lighting. The desirability of generating the power for all these various uses at a central point and then distributing it to points of consumption is emphasized by the thorough and substantial character of the design of this plant. No more complete or better equipped power plant has ever been installed for use in connection with a railroad repair shop.



EXTERIOR OF POWER HOUSE, SHOWING COAL CAR OVER UNLOADING HOPPER AND ASH STORAGE ABOVE. WELL HOUSE IN FOREGROUND AT RIGHT.

As was pointed out in the initial article of this series (November, 1903, page 398), while the power plant is situated some distance to the south of the geographical centre of the shop layout, it lies very close to the centre of power consumption of the entire shop layout, including both locomotive department and the proposed car department shops, which is the governing factor in power transmission. A glance at the layout drawing of the McKees Rocks shops, in the above-mentioned article, will show, furthermore, that its location is most convenient for the operation of the water-supply system and the heating system for the shops, and also that easy access for cars to the coal and ash handling apparatus is here provided for by a side track connection.

The power house is a substantial steel and brick building, 75 ft. x 100 ft. in size inside, with a clear vertical height of 27 ft. beneath the roof trusses. It is divided by a division wall into a boiler room, 38 ft. wide, on the south side and the engine room, 34 ft. wide, on the north. There is a spacious basement, having 10 ft. of clear height beneath the floors, surrounding the boiler and engine foundations and giving easy access to the auxiliary machinery and piping systems. In the basement is also located a very convenient and well appointed bathroom and lavatory for the convenience of the attendants.

The important details of the building are well shown in the accompanying cross section and plan views of the plant, which also show the arrangement of apparatus. The external

views will show the appearance of the power house. The construction indicates a liberal use of concrete in foundations and floors, tending to render the plant fireproof. Both the wall and the engine foundations are of very substantial construction. The engine room roof is supported by steel trusses resting upon wall columns ending in heavy brackets at the top, as shown in the cross section; the boiler room roof trusses extend only from the division wall to the row of columns placed in line with the boiler fronts to support the coal storage bins, the remainder of the span being covered by a separate narrow roof over the coal bins. The wall columns in the engine room are enlarged to a height of 18 ft. above the floor to carry the runways for the traveling crane, which is a 10-ton hand-operated traveling crane built by Maris Bros., of Philadelphia, Pa. This crane is constructed of 4-ft. plate girders and has a span between crane tracks of 32 ft.

The steam generating equipment of the plant consists of six Babcock & Wilcox vertical header water-tube boilers, each of 264 h. p. rated capacity at 150 lbs. steam pressure. They are installed in three batteries of two boilers each and are conveniently arranged with intervening spaces for access.

The estimated maximum load, including that required by the locomotive washing out plant, was 1,500 boiler horse power. It was found that this was approximately right, though at the peak of the load on cold days during last winter the load was above that. Yet four boilers were found sufficient, and thus there were two boilers in reserve.

These boilers involve the latest improvements and best approved construction of the Babcock & Wilcox Company including recent improvements in pressed steel headers and steam drum flanges and fittings.

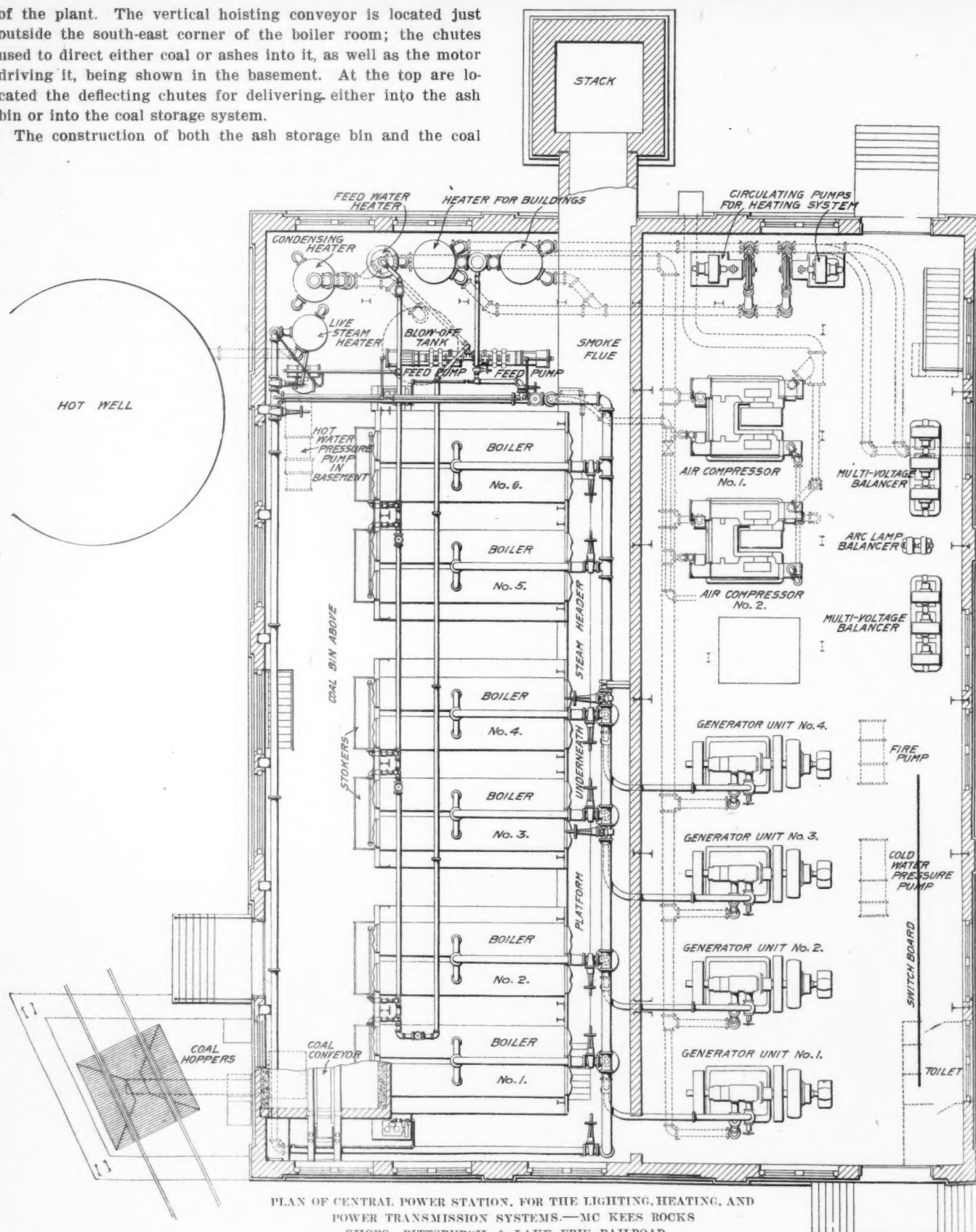
Each boiler is equipped with a Roney mechanical stoker for automatic firing. Each stoker is 100 ins. wide and is 20 grates deep. Coal is delivered into the stoker hoppers directly from chutes leading from the overhead coal bins, and the stokers are driven by a 4½ by 4-in. Westinghouse standard stoker engine. Natural draft is supplied for the fires by a Custodis brick stack, located outside the boiler room, as shown on the plan drawing, and connected to the various boilers by a breeching of structural steel and fire-brick construction. The stack is 135 ft. high above the grates and is 8 ft. in diameter inside. The flue connections are well provided with dampers for regulating the draught or cutting a boiler out for repairs.

The coal and ash handling equipment of the plant is very complete. As may be seen from the layout plan (November issue, 1903, page 396), coal is delivered to the power plant by a spur track, leading past one corner of the boiler room. This track passes over a receiving hopper, into which the coal may be dumped directly from hopper cars. The coal thence passes through a proper grating and is hoisted by an endless-chain bucket conveyor, of the Heyl and Patterson type, to the top of the building. From here it is dumped onto a horizontal conveyor, which deposits at the points desired in the storage bins located in the upper part of the boiler room and arranged to feed into the stoker hoppers directly by chutes. The hoisting mechanism is operated by a 10-h. p. Crocker-Wheeler motor in the basement and the horizontal conveyor by a 7½-h. p. motor of similar make; the actual power required by the two conveyors when running is, however, about 7½ and 4 h. p. respectively. The capacity of this hoisting and conveying equipment is 40 tons per hour, the total storage capacity of the coal bunkers being 200 tons.

The ashes are handled by the same hoisting conveyor as is used for the coal, a storage pocket for the same having been arranged upon an elevated structure above the coal receiving track. In this way, when a carload of coal has been dumped into the receiving hopper below, the car may be utilized for removing the ashes without further shifting—they are merely dumped from the hopper above. The ashes are handled from the ash-pits beneath the boilers by special wheelbarrows and then dumped into the hoisting conveyor, which may be arranged to deliver at the top into the ash hopper side. The complete arrangement of this coal and ash handling system of conveyors is clearly shown by the cross-section drawing

of the plant. The vertical hoisting conveyor is located just outside the south-east corner of the boiler room; the chutes used to direct either coal or ashes into it, as well as the motor driving it, being shown in the basement. At the top are located the deflecting chutes for delivering either into the ash bin or into the coal storage system.

The construction of both the ash storage bin and the coal

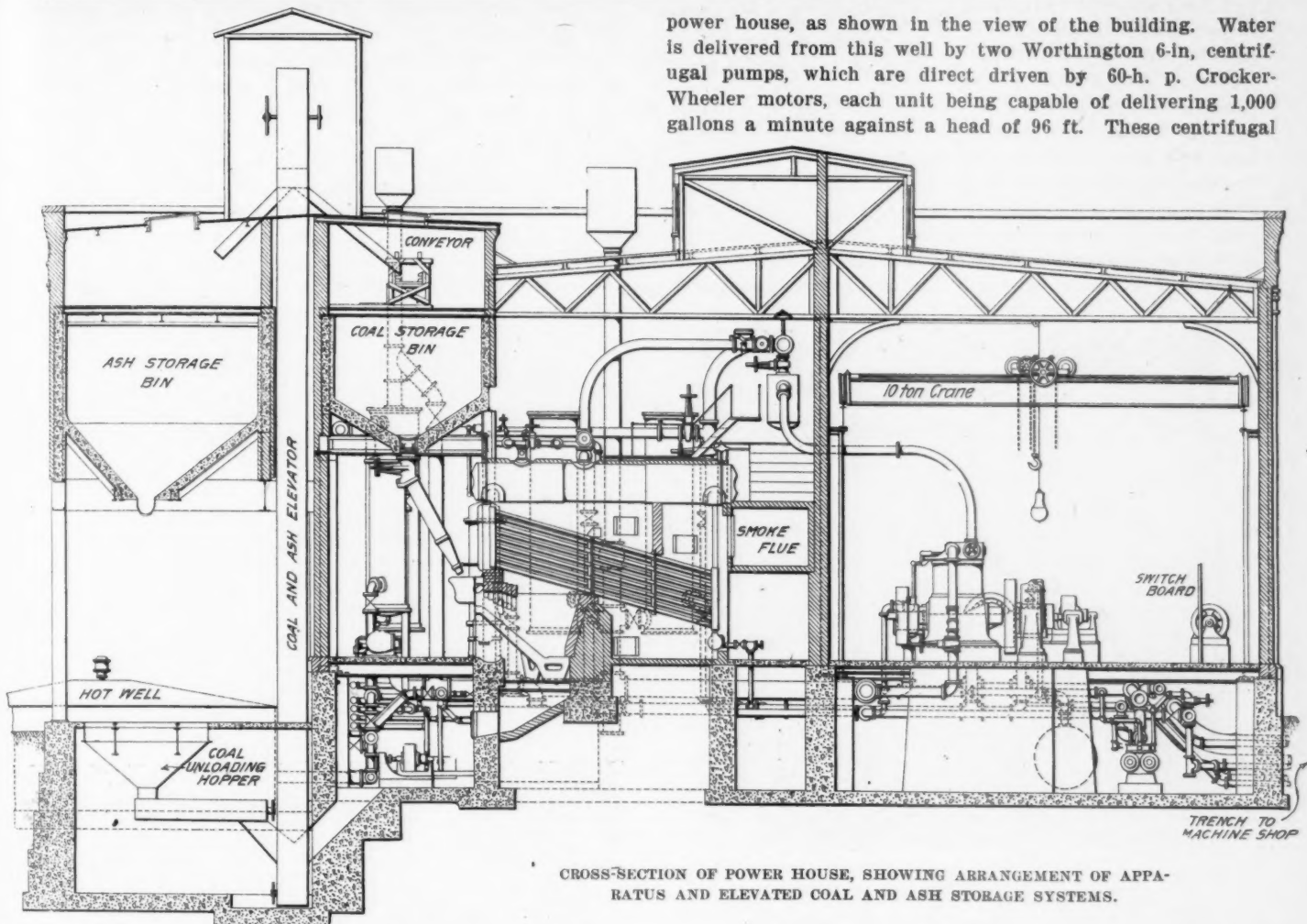


PLAN OF CENTRAL POWER STATION, FOR THE LIGHTING, HEATING, AND POWER TRANSMISSION SYSTEMS.—MC KEES ROCKS SHOPS, PITTSBURGH & LAKE ERIE RAILROAD.

storage hoppers is well shown in the cross-section. The ash bin is of concrete upon steel framework, with the lowest point of the hopper 16 ft. above rail level. The coal hoppers, six in number, are of similar construction, with their outlets 12 ft. above the boiler room floor. The coal outlets are controlled by special gate valves operated from the floor by chains passing over the wheels. The coal is distributed to the various pockets by the horizontal conveyor shown, which may be arranged to dump at any point. A protection for the top of the hoisting conveyor is provided for by a small enclosure above the roof; this is well shown in the exterior view of the power plant.

A very complete system of boiler room auxiliaries has been installed in the plant. The boilers are fed by two outside-packed Worthington pumps, with "pot valves," having 9-in. steam cylinders, 5-in. water cylinders and a common 10 in. stroke. Water is delivered from these pumps to the boilers through a Goubert hot water heater of 1,000 h. p. rated capacity. The main feed line to boilers is of brass pipe and fittings throughout, and to further minimize any danger from interruption of feed water supply the feed line forms a loop so that any section may cut out. In addition to the boiler-feed pumps, there is a large 16-in. by 10¼-in. by 10-in. stroke Worthington fire-pump in the engine room basement, which is

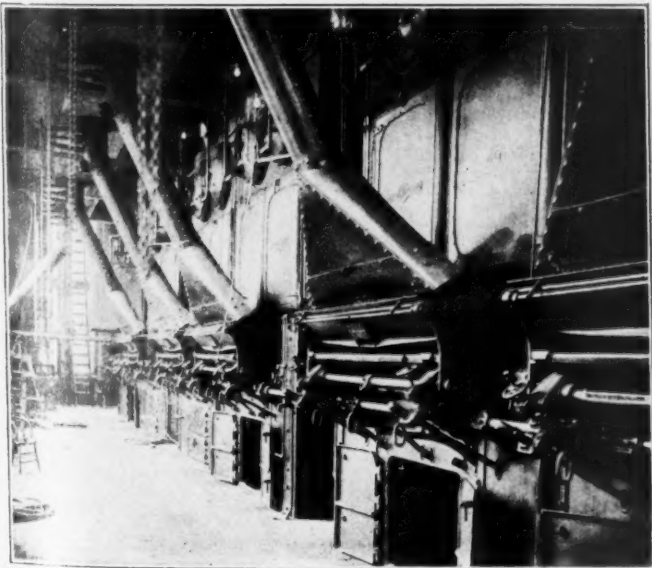
power house, as shown in the view of the building. Water is delivered from this well by two Worthington 6-in. centrifugal pumps, which are direct driven by 60-h. p. Crocker-Wheeler motors, each unit being capable of delivering 1,000 gallons a minute against a head of 96 ft. These centrifugal



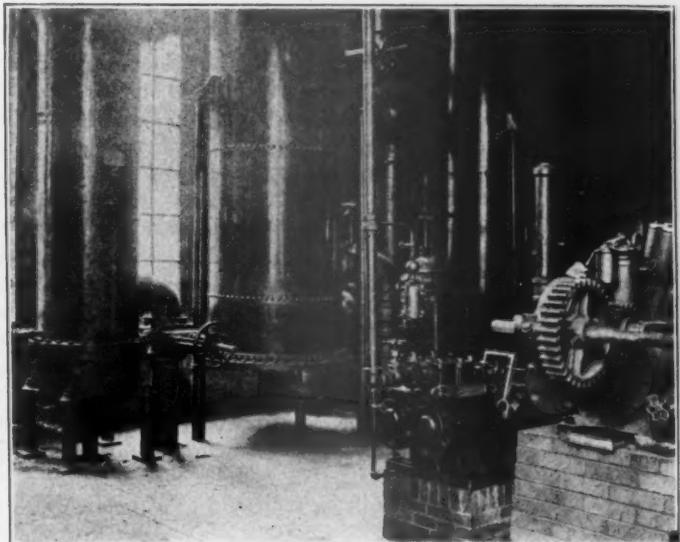
CROSS-SECTION OF POWER HOUSE, SHOWING ARRANGEMENT OF APPARATUS AND ELEVATED COAL AND ASH STORAGE SYSTEMS.

capable of throwing four $1\frac{1}{8}$ -in. fire-streams. This is connected to a system of high pressure fire-mains, leading to hydrants, located at convenient positions on the shop grounds. There is also a low-pressure water pump for supplying water to the lavatories and other low-pressure water

pumps are located down in the well pit at a level above the water, as shown in the accompanying engraving from a photograph taken looking vertically downward upon them; this is a remarkable photograph, corresponding as it does to a plan drawing, and it was taken under great difficulties by Mr. R. T. McMasters, of the engineering department of the system.



BOILER ROOM, SHOWING COAL CHUTES FROM STORAGE HOPPERS ABOVE. BARBOCK AND WILCOX BOILERS.



FEED WATER HEATERS AND BOILER-FEED PUMPS IN BOILER ROOM. STOKER ENGINE AT RIGHT.

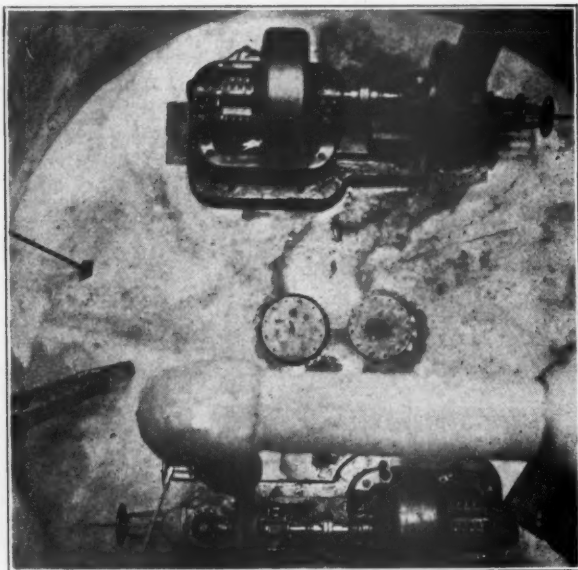
service through the shop buildings. The latter pump, which was built by the Warren steam Pump Company is an 8-in. by 6-in. by 12-in. stroke pump of 300 gallons per minute capacity. A superheater drip discharge pump, 6 by 4 by 6 in. in size, automatically controlled, complete the auxiliary equipment.

Water is supplied to the plant from a large well outside the

The space in the well is large enough to accommodate two additional pumping units. These pumps deliver the water to the top of the Kennicott water softener near by, which has been described in recent issues of this journal, where it is chemically treated and then flows by gravity to the various pumps in the power plant. There are, of course, the necessary by-pass connections, so that raw water may be delivered di-

rect from the well to the pumps, if desired, or in emergency.

In addition to the boiler auxiliary pumps there is installed in the power plant a complete equipment of steam pumps, including a cold-water pressure pump, a hot-water pressure pump, a high pressure testing pump, etc., for use in connection with the new system of boiler washing and testing, which is being installed at the McKees Rocks roundhouse and shops. The hot and cold water pressure pumps are both compound steam pumps, with cylinders 12-ins. and 18 ins. by 12 ins., with common 18-in. stroke, and each has a capacity of about 1,000 gallons per minute. The high pressure pump for testing of locomotive boilers has cylinders of 6 and 2½ ins. diameter by



PLAN VIEW OF MOTOR-DRIVEN CENTRIFUGAL WATER-SUPPLY PUMPS, IN WELL PIT.—VIEW TAKEN LOOKING VERTICALLY DOWNWARD.

6 ins. stroke, and has a capacity of 30 gallons per minute against a pressure of 300 lbs. The latter pumps were all supplied by the Warren Steam Pump Company. The piping for the pumps is carefully arranged, so that nearly any pump can be quickly connected up for any service; in this way a complete interruption of any of the different services is almost impossible.

The arrangement of the apparatus in the engine room, as well as in the boiler room, is indicated in the plan drawing. The electrical generating units and the air compressors form the principal part of the engine room equipment, but there are also the two motor-driven centrifugal pumps for the heating system, at one end, and the three balancer units for the 4-wire multiple voltage system and the arc lighting system, at the side, next to the switchboard. The centrifugal hot-water pumps at the west end, together with the two large water heaters at the west end of the boiler room, will be referred to in the following article of this series in connection with the shop heating system, which is operated on the hot-water-recirculating system; the heaters are used to heat the circulating water for the radiators while the centrifugal pumps serve to force the water through the heating pipe system.

The two air compressors are located between the centrifugal pumps and the main engines, as shown in the foreground in the engine room view. These are the well-known "Imperial" type of air compressors, built by the Rand Drill Company, and supply compressed air for the various uses about the roundhouse and shops. Each machine has a capacity of compressing 1,000 cu. ft. of free air per minute to a pressure of 100 lbs. per sq. in.

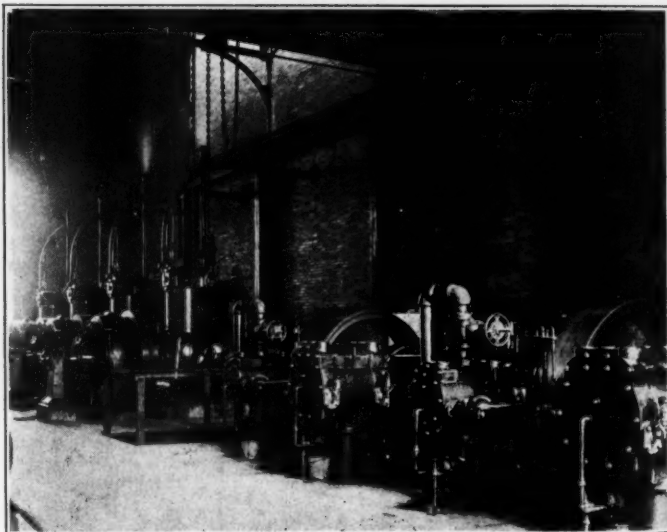
The electrical generating units, of which there are four, consist of standard Westinghouse single-acting non-condensing compound engines, direct-connected to Westinghouse dynamos of the multipolar engine type, with outboard bearings. The engines have cylinders 14 and 24 ins. in diameter with a 14-in. stroke and operate at a normal speed of 280 rev. per min. Their rated capacity at this speed and with the normal steam pressure of 150 lbs. is 250 h. p. These engines are

equipped with the usual centrifugal type of shaft governor, and are designed with particular care with reference to speed regulations; they all have similar characteristics in this respect, so that the power delivered is proportional to the load.

The engines are conveniently equipped with an elevated platform, permitting access to the throttle valves and valve gear, this platform leading from one engine to another. Practically the entire operation of the engines is controlled from these points. The arrangement of the generating units is well shown in the engine room view presented herewith.

The generators are direct-current multipolar machines of the direct-connected engine type and each has a capacity of 150 kilowatts at a voltage of 240 volts. These generators are over-compounded sufficiently to maintain the voltage throughout the entire range of load and overload, and each machine is guaranteed to be capable of carrying an overload of 50 per cent. above its rated capacity for one hour immediately following a 24-hour full load test and overloads of 75 per cent of short intervals. All the generators feed to common bus bars on the switchboard, which causes the total load delivered to be shared equally among all the machines in service.

In the design of the electric generating equipment, it was estimated that, at the "peak" of the load, which will come in the winter months, when, in addition to the usual motor load, all the lighting will be in service, all four of the generators will be required in service. During the past winter never more than three units were in use at one time. But as this "peak" will last for only a few hours at a time on each dark winter day there will be obviously ample opportunity to keep



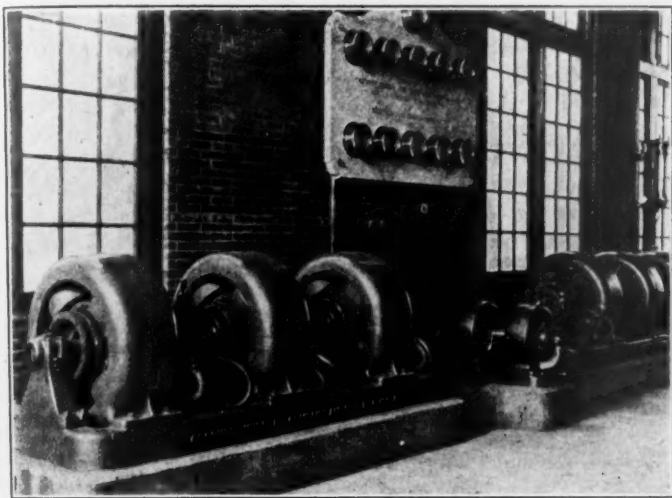
ENGINE ROOM VIEW, SHOWING STEAM PIPING ARRANGEMENT. RAND AIR COMPRESSORS AT RIGHT.

the machine in good repair. In fact, on the average, only from two to three machines will be kept in service, varying according to the load, which will practically leave one unit free, for repairs and the necessary attention to be given it at leisure. Space has been left in the engine room, however, for an additional generating unit to be installed, if required by growth of the load.

A large 18-panel switchboard is used for controlling the current from the generating units and also that for the various distribution circuits. The board is beautifully constructed of 2-in. blue Vermont marble, mounted upon a substantial angle iron frame and located 5 ft. from the wall, so as to permit ease of access to the connections at the rear. An excellent view of this board is presented in an accompanying half-tone. The fittings upon the switchboard were designed for neatness of appearance and the marble was carefully selected for freedom from metallic strata. The board was built by the H. Krantz Manufacturing Company; it is 7½ ft. high by 32 ft. 8 ins. long.

The four panels at the left end of the switchboard contain the necessary apparatus for controlling the generating units, one being used for each machine. The fifth panel contains

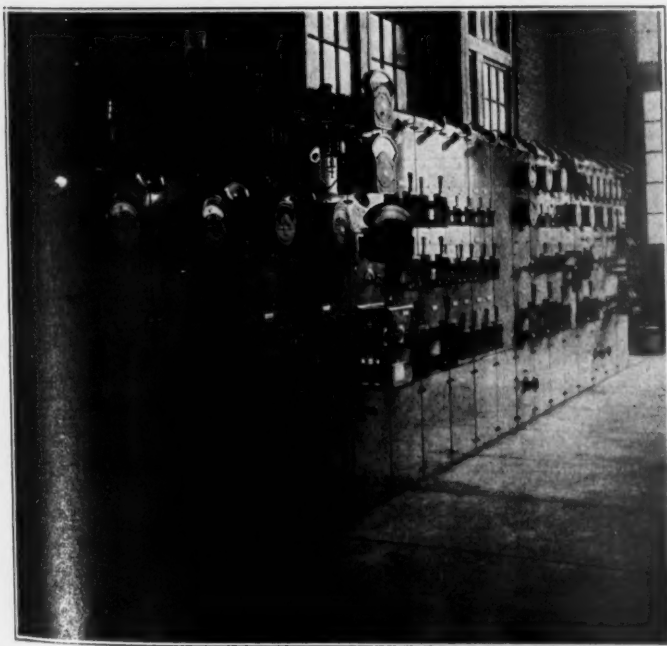
the indicating and recording ammeters and other apparatus for a total load panel. The remaining 13 panels are for the distribution circuits as follows: Panels 6, 7, 8 and 9 control four principal power circuits, which deliver current to the constant speed motors and to the incandescent light circuits, the tenth panel being held in reserve for extensions. Panels 11, 12 and 13 are used for the arc lighting system, the eleventh being used to control the circuits for the arc-light system balancer unit. The remaining panels are devoted to the multiple voltage circuits; panel 14 is the power-controlling panel for the multiple-voltage, variable-speed motors; the following



DUPLICATE BALANCERS FOR THE MULTIPLE-VOLTAGE SYSTEM AND SMALL COMPENSATING BALANCER FOR THE ARC LIGHTING SYSTEM.

three panels control the Crocker-Wheeler balancer units for this system, and the last panel controls the 4-wire multiple voltage feeders.

In the illustration which shows the beautiful marble pressure-gauge board in the engine room, may also be seen two of the three-unit rotary transformers, which are used as balancers for the 4-wire multiple-voltage distribution system. As is



THE SWITCHBOARD, CONTROLLING ALL POWER AND LIGHTING DISTRIBUTION CIRCUITS.

well known, the balancers are used for the purpose of generating the intermediate, or "low" voltages, which are interposed between the two main voltages that are generated by the main dynamos. The principle of the multiple voltage system is generally well understood, but for further details we would refer our readers to the extended description of this system of variable-speed electric driving, which appeared in connection with the series of articles describing the Collinwood

shops of the L. S. & M. S. Ry. The characteristic features of the multiple voltage system were referred to in detail in that series on pages 23 and 24 of our January, 1903, issue. The different voltages made available by this system are 40, 80, 120, 160, 200 and 240 volts, as is the case at the Collinwood installation. These balancers were installed in duplicate on account of the importance of maintaining uninterrupted service for the machine tool driving. Each balancer has a capacity of 35 kw.

In addition to the two balancer units may also be seen a small two-unit rotary transformer, or balancer, which is used in connection with the arc-lighting system. The arc lights which are used in the shop and yard lighting system are operated at 120 volts; inasmuch as the main generator voltage is 240 volts, this necessitated the operation of the arc lights upon the 3-wire system. The balancer serves the purpose of equalizing the division of load upon the two sides of the system, which it does automatically; if the load is equally divided it has no work to do, and is only called into operation when the load becomes out of balance. The capacity of this balancer is only $3\frac{1}{2}$ kilowatts; this seems small, in view of the fact that the arc lamps require a total of 150 kilowatts, but it is found that the lamps balance each other very closely on the two sides of the circuits. It has been found that the unbalanced load rarely becomes more than $7\frac{1}{2}$ amperes. The arc lamps used are the Adams-Bagnall 120-volt lamps, of the long-burning enclosed-arc type; the incandescent lamps operate directly upon the main 240-volt circuits.

This interesting plant was designed by the engineering firm of Westinghouse, Church, Kerr & Company, New York, under the supervision of the engineering department of the Pittsburgh & Lake Erie. We are greatly indebted to Mr. A. R. Raymer, Assistant Chief Engineer, and to Mr. G. M. Campbell, Electrical Engineer, for this information.

MASTER CAR BUILDERS' DROP TESTING MACHINE.—This machine, which for some time has been in process of erection, is now completed and ready for use. It will be remembered that, by direction of the association, this machine has been installed at the laboratory of Purdue University, Lafayette, Ind., where it will be operated under conditions similar to those prevailing in connection with the Master Car Builders' brake shoe testing machine and the Master Car Builders' air brake testing rack. The conditions are such that the machine may be used not only by committees of the Master Car Builders' Association, but also by individual railway companies and manufacturers as well. The machine has already been described in detail in the proceedings of the association for 1903. It is especially designed to test couplers, draft gears, axles, rails and bolsters. Parties interested in making use of the machine should communicate with Prof. W. F. M. Goss, Dean of the Schools of Engineering, Purdue University, Lafayette, Ind.

RAILWAY STOREKEEPERS' ASSOCIATION.—This new organization, which was started last February, promises to be an important one in improving the administration of store departments of railroads and in the handling of supplies. The organization is one which should secure the interest and co-operation of motive power officials because of the importance of proper handling of material, which has a very definite bearing upon the cost of work in locomotive shops. The association is quite new, and it promises to become valuable in introducing commercial principles into this department. Mr. J. P. Murphy, general storekeeper of the Lake Shore & Michigan Central Railway, Collinwood, Ohio, is the president, and the first annual meeting for the consideration of business will be held in Chicago during the current month.

HIGH SPEED LOCOMOTIVE.—The three-cylinder locomotive designed and built by Henschel & Son, Cassell, Germany, in a trial run between Gottingen and Bovenden, made a speed of 78.74 miles per hour, on straight track. It is to be tried on the experimental track between Marienfeld and Zossen, where the famous electric locomotive tests have been made. This is known as the Wittfeld locomotive, from its designer, who is connected with this firm of builders.

APPRENTICE SCHOOLS ON ENGLISH RAILWAYS.

EDITORIAL CORRESPONDENCE.

LONDON, ENGLAND.

America has much to learn from England with respect to apprenticeship in the mechanical trades. England is not only well supplied with apprentices, but with facilities for educating them outside of the shops. I spent some time in looking over the situation of apprentices on the railroads and was surprised, not only by the numbers of apprentices, but with the fact that systematic educational methods have been in operation for fifty and more years on the leading English roads. It may be said that every important road has its *Mechanics Institute*, whereby the boys may acquire advancement mentally to correspond with their progress in mechanical skill. Some of these institutions would take high rank among our technical schools, although they do not aspire to the grade of engineering colleges.

Some of the English roads have faithfully provided apprentice school instruction for years and for generations, and this is one reason why there is no lack of skilled mechanics in every trade. The efforts of the railroads are worthy of special comment.

There are usually three grades of apprenticeship in the motive power departments.

1. Pupils—Who are sons of influential men and pay for the privilege of studying railroad work. The superintendent of motive power usually receives the premiums paid by these pupils, as one of his perquisites. The pupils do as much or as little work as they choose.

2. Premium Apprentices—Who are also sons of well-to-do parents and pay for the shop privileges. They often receive wages which offset the premiums they pay. These are generally technical school graduates and in the shop they are practically the same as our "special" apprentices.

3. Workmen's Apprentices—These are sons of the workmen and they form the largest class of apprentices. These boys apply for apprenticeship in large numbers and this constitutes the recruiting source for shop men. They are allowed to learn the trade of their fathers and are not, as a rule, allowed to take up any other trade, but they are carefully taught in the shops and finish as good mechanics.

Because the workmen's apprentices are the recruits for the shops this class is the most important in my investigation. Locomotive engineers and firemen are usually taken from the shops, therefore the road service of the department is also recruited through this form of apprenticeship.

In England there is no lack of the best mechanics, because there are plenty of boys who wish to learn trades and the trades unions are not restricting the numbers of apprentices, as they are in this country.

The pupil system, while quite general in England, places a lot of privileged characters in the shops and is not to be commended. The premium apprentice may be left to be dealt with at another time. The regular or workman apprentice is the important one and he is well provided for on English roads. The following observations concern this class:

Great Eastern Railway—For 52 years this road has conducted and provided a Mechanics' Institute for apprentices, with evening classes for all who desire to take advantage of them. Mr. Holden believes in giving the ordinary apprentice a chance. He does not entirely approve of night schools for boys who work hard all day. Those who have served three years and have regularly attended the evening classes, may, by approval of the Mechanics' Institute committee, be allowed leave of absence with pay for two or more winters in order to attend higher technical schools. These students report to the locomotive superintendent every month and they are provided with facilities for visiting the works of other companies. One such visit is made every month during the winter. This part of the scheme has not been long in use, but thus far has worked well. Annual prizes are awarded for proficiency at the Me-

chanics' Institute and the distribution of the prizes is made a notable occasion and is attended by Lord Claude Hamilton, chairman of the board of directors who, last year, distributed the prizes. At the ceremony last year Mr. Choate, United States Ambassador in an address said: "These Mechanics' Institutes are the best hope of the people of England." The library of the Institute of this road contains 9,000 volumes.

London & Southwestern—Mr. Dugald Drummond, chief of the locomotive department of the London & Southwestern, has put into practice a scheme for day classes for apprentices at a technical college, near the Nine Elms works in London. Competent teachers are provided by the company and the apprentices may spend one hour a day, three days a week, from 8 to 9 a. m. at the school, which forms part of the day's work, without loss of pay. Preliminary examinations are required, and at the end of three months in each term, progress examinations are taken. Those who pass all examinations satisfactorily are allowed to attend the engineering colleges during the winter months to secure a higher education and the time so spent is accounted as part of the apprentice course. Those who successfully pass the college examinations are allowed to work in the laboratory or drawing office during the summer months. The first calls for promotions are made from the apprentices who have shown ability, both in the shop and the school. Mr. Drummond has made the following standing offer: "Any lad whose parents have not the means to keep him sufficiently long at school to give him an education, such as would qualify him to pass the preliminary examinations, will call upon me and I shall endeavor to make such arrangements as will enable him to require the necessary knowledge to do so."

This road does not conduct the school, but it does provide the salaries of the teachers and bears all the expense which would ordinarily fall upon the students.

Great Western Railway—This road has for thirteen years provided a series of evening classes for apprentices and shop men. They now have a large library and reading room at Swindon, and have turned the technical school over to the town, but retain control of the instruction through the officers of the locomotive department. This road has about 12,000 men in the shops at Swindon. The best apprentices are allowed to attend day classes at the technical school and are allowed full pay for the time so spent, and the school fees are also paid by the road. These candidates must be registered apprentices, between 17 and 18 years of age, they must have spent at least one year in the works and must have regularly attended at least one session in the preparatory evening classes in the technical school. Thirty such day students are provided for and they take three years' courses. They study practical mathematics, practical mechanics, geometrical and machine drawing, heat, electricity and chemistry. The students who distinguish themselves are allowed during the last year to spend part of their time in the drawing office and chemical laboratory of the road. The whole plan is at all times under the control of the head of the locomotive department. The regular evening classes at the school have been arranged with special reference to the needs of railroad shop apprentices and are divided into two grades, the preliminary and the engineering. The laboratory equipment of the school is extensive and excellent.

London & Northwestern—At Crewe a well-equipped Mechanics' Institute has been maintained for 58 years. For 32 years Mr. F. W. Webb presided over it. In 1847 the cost was \$1,000 for the year. In 1903 it was \$15,000, not including the cost of the buildings and equipments furnished by the company. The Institute is a high grade technical high school and prepares for college and higher technical schools. It has well-equipped laboratories and is an impressive establishment. It has a library of 11,200 volumes. Small fees are charged for tuition in the various classes and the road makes up the deficiency in operating expenses. Last year students received 255 certificates from the board of education for graduates. This school has furnished 51 Whitworth scholars by competitive examination. It is doing a remarkable work. This road has

1,077 apprentices at Crewe and 8,000 workmen. The reports of the Mechanics' Institute are exceedingly interesting and far ahead of anything we have in this country. This school has taken more Whitworth scholarships than any other one institution in England. Seven scholarships are provided by the Government at the Royal College of Science at London and Dublin. These are awarded by competition and the successful candidates are prepared to compete for Whitworth scholarships. This school work is not in any way compulsory. The newest development is an electric laboratory in which 36 pupils may work at the same time. It is equipped for railway electric work exclusively, and is used Wednesday afternoons, under an instructor, provided by the company.

Lancashire & Yorkshire—This road has a large Mechanics' Institute in connection with the Horwich shops, which are among the best shops in England. The classes are taught by men who actually work in the shops. Metallurgy is taught by the superintendent of the steel foundry. Chemistry is taught by the chemist of the road and drafting by the draftsmen. The result is that though attendance is purely voluntary, the establishment is completely filled every winter evening. They have their own young men to take up their electrical work of their new electric lines now in service.

Night schools are not approved by the most progressive railroad men in England. They do not believe in night classes for growing lads after a full day's work and they are unquestionably correct.

Other railroads have these apprentice schools but I mention only those which I investigated personally. I have printed matter in my possession concerning all of these; and it constitutes an interesting record of an effort to "give the workman's son a chance."

Manufacturing Concerns—Such concerns as Yarrow & Company; Richardsons, Westgarth & Company; Palmer's Shipbuilding & Iron Company; William Denny & Company and Andrew Barclay Sons & Company, provide very comprehensive schemes for apprentice education by evening classes and encourage efforts by means of prizes awarded annually. The details of these plans are very interesting. Mr. Yarrow has, at his own expense, sent a representative educator to the United States, who thoroughly investigated technical school developments for the purpose of aiding him in providing for his own apprentices. This indicates the high place the subject holds in the minds of the leaders in engineering work in England. Mr. Yarrow believes that a concern employing 4,000 or 5,000 men can successfully inaugurate and conduct its own schools with the very best of teachers. This is a suggestion to the big American railroads. Smaller concerns should depend on the existing school facilities.

British Admiralty—For over 40 years the British admiralty has followed a plan for apprenticeship whereby the winter months are spent in college and the summer months in the work shops. "This method has produced a famous roll of chief constructors." The same plan is followed by the Scotch universities; the students study in the winter and work in the summer.

Sandwich System—In England the belief is growing among employers of men that school work and shop training must go hand in hand. The boys must turn from one to the other every day. This is called the "sandwich" system and it is admirably applied so that the shop boys may advance in studies and mechanical proficiency at the same time.

Provide for Workmen's Sons—Mr. J. A. F. Aspinall, general manager of the Lancashire & Yorkshire Railway, says, "Consideration ought to be given to the rank and file of the workshop, those who were not born with a silver spoon in their mouths, and who ought to be able to get on and advance themselves if they have sufficient brains, and ought to have facilities for rising to the top. From this class the most distinguished men in England have sprung." Aspinall, Drummond and Yarrow are firm advocates of thoroughly educating the workmen's sons.

Social Limitation—Exceptions—Mr. W. H. Maw believes that "Care must be taken that every facility to rise be given to the

best man, irrespective of social position. Such men will be most frequently found among those not endowed with wealth who in consequence had inherited the instinct for work, and by example and necessity will be more ready to go through the drudgery of learning their profession than those who were what is termed "socially above them."

In spite of frequent expressions in favor of aiding the rank and file, it is, because of social distinction, very difficult for a shop boy to rise and become a "gentleman." I must say, however, that some of the finest and broadest-minded men I met in England have come from the ranks to the highest positions, and these very men owe this advancement to the Mechanics' Institutes.

Necessity for Schools—Mr. Hugh Reid of the Hyde Park Locomotive Works, says: "Every engineering firm, if working on sound commercial lines, must look to the education of its apprentices, more particularly from its bearing upon its own business, present and future. The more a business is removed from the purely manufacturing processes, and where new designs and developments are constantly required, so correspondingly will a larger number of highly trained workmen be required. Also in works far removed from or very close to large centers of population, highly trained men may in the one case be very difficult to obtain and in the other, very difficult to retain."

This means that for self preservation school instruction must absolutely be provided for apprentices and that it must be done by and under the control of the employers. In the United States the methods described will not answer. Our conditions require methods specially adapted to a relatively new country and to railroads which lack the traditions of these in England. As a result of these observations I have formulated a plan which when developed will be ready for the consideration of American railway officials. It is necessary to provide a system which while under centralized direction and control will meet the needs of railroads having many centers of mechanical work. The English methods do not provide for this.

I trust that this general discussion of the subject may awaken and incite interest in this tremendously important matter, than which there is nothing more vital in the entire labor problem.

G. M. B.

(To be Continued.)

The oil-burning engine district on the Santa Fe has been extended from Seligman to Winslow, Arizona, a distance of 143 miles. Coal-burners are not used any more in California or Western Arizona. Instead of storing oil in steel tanks at division points, the Santa Fe has built circular pits in the ground, banked up high, with a depth of about 20 feet, and roofed over. The oil thus stored is pumped into small delivery tanks and there run into the engines by gravity. The largest of these pits are at Seligman and Flagstaff—one for each place, each holding 50,000 barrels. At Ash Fork there are two pits, each holding 25,000 barrels; at Williams one and at Winslow one, each holding 25,000 barrels. There is little loss by leakage. The earthen pits cost less than steel tanks and hold more oil. The fire hazard is greatly reduced.

"Since the use of soft water decreases the time necessary for keeping locomotives out of service for boiler repairs, and for washing out, the number of locomotives required to operate a line should be decreased. Your committee has found published statistics covering a period of time on a division of a railroad that recently was equipped with water-softening plants. These statistics show that the number of locomotives in service was 9 per cent. less, the ton mileage 11 per cent. more, and the pounds of coal consumed per 1,000 ton miles was 5 per cent. less than during the same period before the division was equipped with the water-softening plants."—*From a committee report on water softening, to the Engineering and Maintenance of Way Association.*

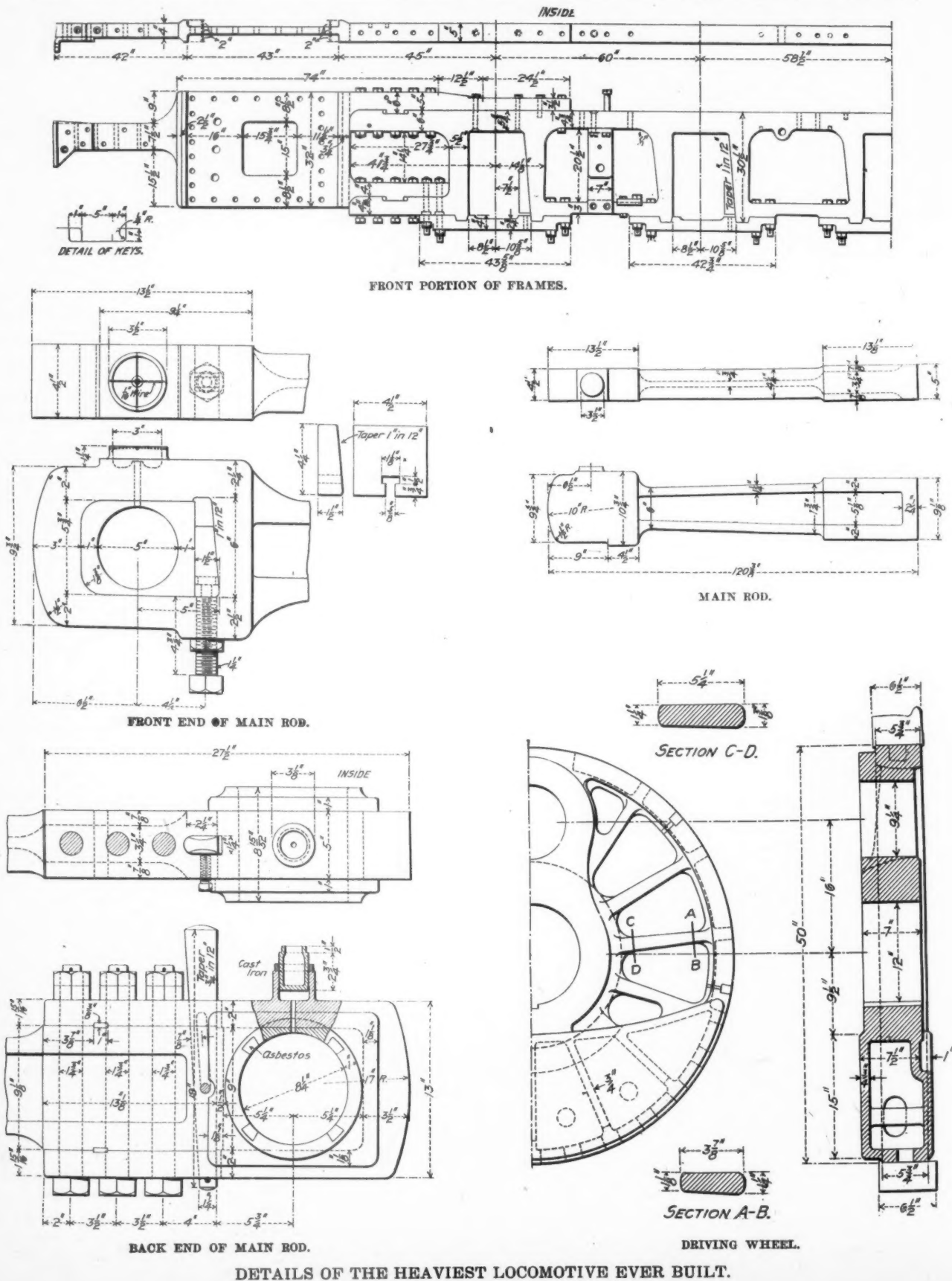
SOME DETAILS OF A VERY HEAVY LOCOMOTIVE.

ATCHISON, TOPEKA & SANTA FE RAILWAY.

2-10-2 (SANTA FE) TYPE.

In this journal for October and November, 1903 (pages 372 and 399) descriptions of the very powerful freight locomotives built by the Baldwin Locomotive Works for the Santa Fe Railway were presented. Because of its size and enormous draw-

bar pull in starting (69,500 lbs.) some of the details of the running gear will be interesting because they show the large sizes of the parts which are necessary in such an enormous locomotive. While the exact weights of the parts of this engine are not now available, those of some of the principal parts of the 2-10-0 engine illustrated on page 192 of our June number, 1902, will indicate in a general way the corresponding figures for the 2-10-2 type which is very nearly the same size. These weights are given in the accompanying table. The reciprocating weights, including the portion of the weight of the main rod, for one side amount, approximately, to 1,800 lbs.



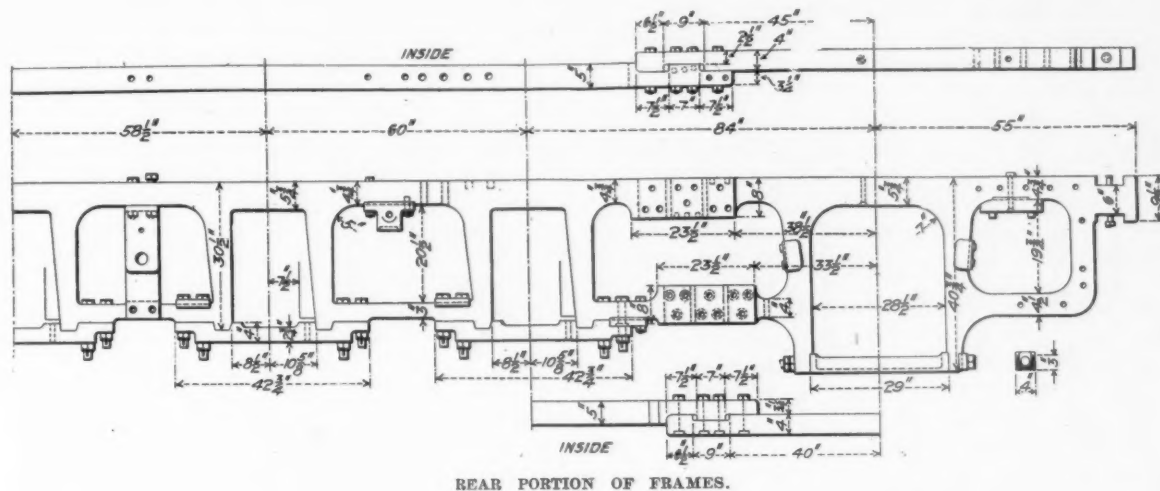
WEIGHTS OF PARTS OF HEAVY DECAPOD LOCOMOTIVE

(See AMERICAN ENGINEER, June, 1902, page 192.)

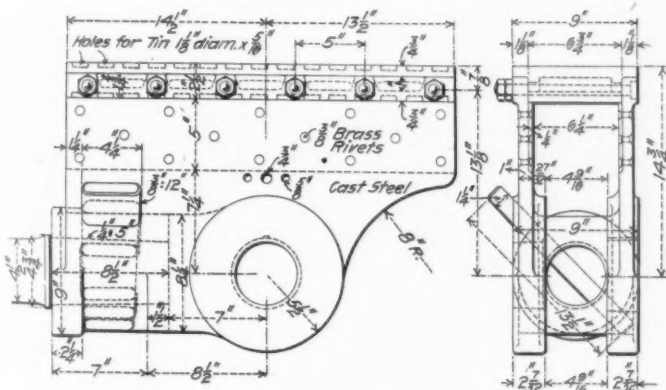
	Pounds.
Weight in working order.....	267,800
Driving wheels and axle, front and back pairs.....	7,475
Driving wheels and axle, intermediate, front and back.....	8,055
Driving wheels and axle, main pair.....	9,375
Driving box, main, each.....	512
Driving box, others, each.....	444
Engine trucks, without wheels, axles or boxes.....	4,500
Engine truck wheels, one pair and axle.....	2,080
Equalizer beam.....	160
Frames, each.....	8,400
Foot plate.....	910
Boiler, without tubes.....	43,000
Cab, steel.....	2,690
Axle, main driving.....	1,875
Axles, other driving.....	1,520
Crosshead.....	431

	Pounds.
Pistons and rod	1,075
Main rods, each	1,030
Side rods for each side.....	1,370
Cylinders, for one side, without saddle.....	10,160
Saddle	7,100

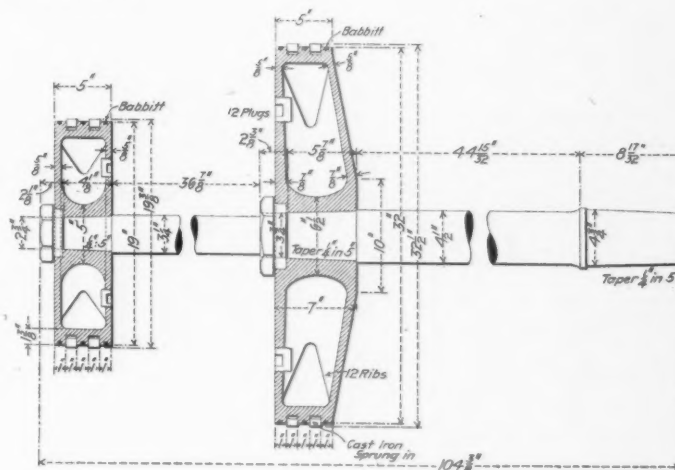
This selection of details for illustration sufficiently indicates the difficulty in designing a very large locomotive. For example a glance at the main crank pin with its $8\frac{1}{4}$ by $8\frac{1}{2}$ in. main rod bearing conveys at once the impression of the power which must be provided for when 19 and 32 in. cylinders are used. The drawing of the main driving wheel shows that there is insufficient room for the counterbalance required by the prevailing rules. Guides 4 by 9 in. in section are required for the



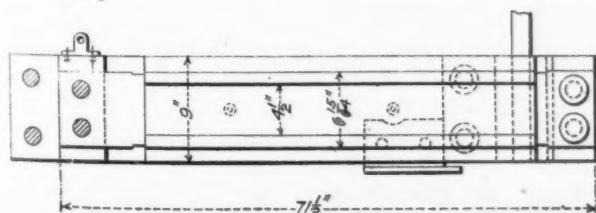
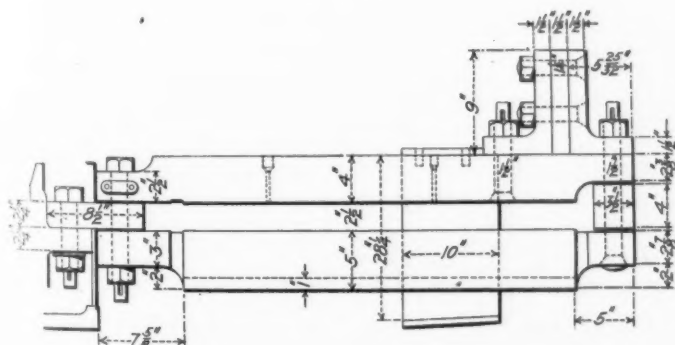
REAR PORTION OF FRAMES.



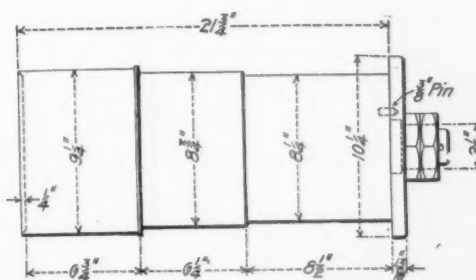
CROSSHEAD.



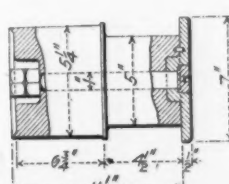
PISTONS AND PISTON ROD.



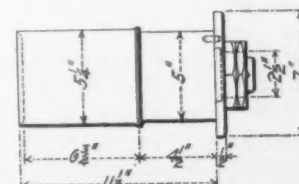
GUIDES



MAIN PIN.



PIN FOR FORWARD DRIVERS.



PINS FOR 2ND, 4TH AND 5TH
PAIRS OF DRIVERS.

CRANK PINS

DETAILS OF THE HEAVIEST LOCOMOTIVE EVER BUILT.

crosshead stresses and the bearing area of the crosshead is 252 sq in. A 32-in. piston is a large member and the two pistons and piston rod are shown assembled. Drawings of the main rod and the frames complete the selections.

A locomotive of this size presents many problems in detail design which have been treated in a most creditable manner which is worthy of careful study by the reader, for in this case forces are provided for which locomotive designers have never before been called upon to meet. In looking over these details as the drawings were lying on the writer's desk, a well-known railroad officer remarked that he thought the time had come when the problem of the big locomotive should be approached in a new way, a way which would divide the stresses in the running gear among a large number of parts and that while this would increase the expense of construction, it would lead to a lightening of the parts, a distribution of the wear over a larger number of surfaces and to greater convenience in the

shop. In fact, he thought that locomotives had gone as far as they ought in the matter of size.

Before leaving the subject, attention should be directed to the frame splices of this engine and to the depth of the frames, 32 in., at the cylinders. In the depth of the frames at this point, the method of securing the cylinders to the frames by long keys, planed together, and the key construction of the frame splices, the practice shown in connection with the 2-8-0 and other classes of Pennsylvania engines has been followed. (See AMERICAN ENGINEER, June, 1899, page 181). In the large Santa Fe engine, it is noteworthy that at the front frame splices a cross sectional area of nearly 98 sq. in. has been provided. These frames have never given the slightest trouble on the road.

These drawings have been received through the courtesy of the officers of the Atchison, Topeka & Santa Fe Railway and the Baldwin Locomotive Works.

MAINTENANCE OF METALLIC PACKING ON LOCOMOTIVES.

By P. A. C. KING.

It is a well-known fact that there are about as many metallic packings on locomotives at the present time leaking steam as there are correctly performing the duty originally intended, and this is due to a large number of causes. The packing manufacturer has often been called upon to produce a fool-proof packing. Now, as soon as we can produce a crank pin bearing which will never require attention or a triple valve that can be put together with a shovel, about that time we may expect a packing, either fibrous or metallic, which will be fool proof, and by the way, it is well to bear in mind that fibrous packings require better attention and greater care in application than any of the metallic packings.

It has often occurred to the writer that it is a pity that packing leakages will not tie up railroads, like broken frames or broken axles or disarranged air brakes, for then the packing would receive the consideration to which it is entitled.

Why is it that metallic packings applied to steamships and stationary engines are steam tight, and when the same are applied to locomotives, they leak steam? The writer thinks the difference is just here: It is impossible to successfully run a marine engine with leaky packings—steam will blow down on the heads of the oilers and the engineers would be compelled to shut down. They are, therefore, particularly careful to see that the packings are in first-class condition and correctly repaired before they leave port, and that by a man who knows his business. While the leaky packing on a locomotive generally does not do any damage immediately, particularly to those running the locomotive, I have often thought that if the front of an engine could be boxed in, and the only outlet to the box be a 2-in. pipe leading into the cab, then we would have tight packings, particularly if this pipe was directly in the front of the cab on the right hand side.

Going back to ancient history, and the days of the old soft packing, usually the engineman did his own work in this respect; he was very careful how he applied the soft hemp rings, and would allow no one but himself to tighten up the gland. He was very careful not to get over-heated rods, and would keep them properly lubricated, as this was the time before oil starvation became a fad. When metallic packings were introduced, for a while the engineman continued to retain interest in the packings, and metallic packings at once showed great saving over hemp, largely because it was looked after the same as before, but since then things have been going from bad to worse between repairs. Finally the "chain gang" came into existence, then the engineman ceased to keep up packings, it being turned over to the shop man, and almost any man was taken for the work. Sometimes this man was a graduate from a wheel barrow, or a bolt cutter. He certainly did not appreciate the work, and as long as he was paid a certain price for renewing babbitt metal rings he considered

his duty was done. Sometimes these rings fit, sometimes they do not; new rings are often applied to packing where rings are not the cause of the trouble, then again they are often improperly machined. In addition to this the oil starvation fad struck us. The best lubrication of packing is from the cylinder. When the quantity of cylinder oil was cut down the packings failed to receive their best lubrication, worn rods were quite frequent, burned out and badly cut packing rings were plainly in evidence.

Now contrast the above with the situation on marine engines. All will admit that the marine engineers are skillful and well informed men, probably as good in a mechanical way as anyone connected with any railroad. Yet these men frequently will not make any repairs themselves on metallic packing, but send to the manufacturer of the packing, so that he may send a specialist to overhaul and correct the trouble. He considers the metallic packing business a specialty, and as it is so important to his existence he has a specialist attend to it. Even on the largest ocean liners this course is often pursued. In some cases, however, after the engineer has had years of experience with the packing, he will then attempt to overhaul it, but never until he has had some experience, watching the packing specialist, and learning his lesson thoroughly. Even our largest ship yards desire the packing specialist present when packings are applied and trials run. This is one of the reasons why marine packings are tight, whereas the same packing applied to locomotives fails. Of course, locomotive service is harder than marine service, but not so much so as to cause the packing trouble and the expense of maintaining packing that now exists when everything is considered. It does not require a college professor to take care of packings, but it does and always will require a good mechanic.

The following is about the way the situation is treated: The general manager goes over the road on a cold, clear day, he sees most of his engines with terrific steam leaks around their cylinders, and immediately thinks it all comes from the packings. He sends for the superintendent of motive power and tells him this thing must stop, that the packings are no good, and they had better change to some other make. The S. M. P. sends for the packing manufacturer, and says, "Your goods are of no account, and something must be done. Can you correct the trouble?" Packing man says, "Yes, but not unless you will treat packings properly." S. M. P. says, "Go ahead." Then a certain number of engines are taken on which to conduct this trial. By a little judicious handling of the question by a man who knows his business, it is found that not only can packings be made tight, but thousands of dollars can be saved per year. The S. M. P. is, of course, very much pleased and shows the matter to the general manager, they proceed to pat each other on the back, and say, "Now the good time has arrived, our troubles with packings are over. Our men have been told how to do the thing and they will do it." All mechanical departments become very virtuous, but view this same road six months after. These packings are again blowing. Nobody, however, pays much attention to it as leaky lines have become the great question of the day and the packing

business is sidetracked for the time being, and the question is asked, "How are you getting along?" "All right, not much trouble, but, of course, we are not obtaining the results that we obtained at first." Now, why is this? Simply because the men who were instructed at the general overhauling have either been put on other work, discharged or promoted, and new men are endeavoring to do their work without being properly instructed. The new men know nothing of the reformation and things gradually drift back into their old condition.

Tests of metallic packing are about as numerous as they are misleading, and this is the reason why about once in six months an entirely new design of packing is placed upon the market and tried on several roads. It has probably made a good record on an engine on some particular road by the inventor. The inventor has daily kept track of the engine and instructed every one how to take care of it, and is sure that it has been well lubricated, even though he may have had to purchase the oil himself. Every one who handles the engine knows the packing is on trial and proceeds to keep it in shape, unconscious of it probably. The result is that the mileage of this packing is very large, and when compared with the mileage of the standard packing on that road it is so large that everyone wants to rush to the new style, and often they do so. When this packing is put on a large number of engines and in time becomes standard and gets the same treatment the old standard received, it proves to be no better, if as good as the old-timer; then the road often in desperation will go back to their old goods. This farce comedy is worked once in about six months, and on some of our best known systems. One motive power man who had sized up the situation correctly, said he could make a big mileage with old shirts in the stuffing boxes providing they were on test.

We may write it down that we shall never get good satisfaction either in the way of preventing steam leakages or saving expense until metallic packings are treated as a specialty, and a good mechanic on every railroad is held entirely responsible for this work. This man should not be a cheap man by any means; he should be paid equally as well as a general roundhouse foreman, he should visit the packing manufacturers and then see that shop men know how to repair packings and that they do it properly. A man of this kind will save many times his salary.

A short time ago a railroad sent some of their engines to a locomotive builder for repairs. The locomotive builder removed the packings and sent them to the packing manufacturer to be overhauled and put in good condition. It was surprising to examine some of these. One packing in particular was minus a ball joint and apparently had not had a ball joint against the gland for many moons, and must have leaked, judging from the way the interior parts of that packing were hammered up. Why the steam leakage did not completely cover the engine I cannot imagine, for it must have been awful. I suppose the engine-man reported these packings as blowing, a roundhouse man with the same regularity applied new metallic packing rings, whereas, if he would have properly sized up the situation and applied a new ball joint, the whole trouble could have been corrected and many dollars saved. Some of these packings were received minus followers, some of them apparently had the followers applied the wrong way about, some of them showed evidence of the vibrating cup being solid up against the side of the stuffing box, either due to excess of lost motion between the piston and cylinder or cross head and guides. In other words, the whole condition was horrible, and neglect in this matter meant a loss of thousands of dollars.

It is certainly unfair to blame metallic packings for faults which may be due entirely to piston rods and valve stems. Sometimes piston rods are not true, cylinders are smaller at one end than at the other, or they may not be round. The same is true of valve stems. Unless they are cylindrical no metallic packing can be expected to be tight. Then again rods are turned up and roughly finished so that they act as a file through the packings, or in truing up rods they may be turned to a size that does not correspond to the diameters of rings kept in storerooms; the roundhouse man in his hurry

is compelled to take rings out of stock such as he may find, and very often has to apply the wrong diameter of rings to the rod. Now, under conditions of this kind, it is about as impossible to expect packings to be tight as it would be to expect a tight slide valve, if the valve face was finished in a foundry instead of a machine. In several instances we have known of rings which were originally bored for rods one-half inch less diameter, cut up in small segments and applied to packings. We may readily imagine how this would work out in practice.

CHICAGO MEETING OF THE MECHANICAL ENGINEERS.

The spring meeting of the American Society of Mechanical Engineers will this year be held jointly with the Institution of Mechanical Engineers of Great Britain, and the sessions will be held in Chicago. This location has been selected because it is near enough to St. Louis to permit the members to attend the exposition and yet the discomforts of holding conventions in the exposition city will be avoided. Thus far 200 members of the English society have indicated their intention to attend, and the joint meetings therefore promise to be very successful. In order to provide ample time for discussion the subjects for the English society will be limited to the following: The steam turbine, motor cars, the gas engine, hydraulic and electric cranes, induction fans and garbage destructors. The committee on meetings of the American Society of Mechanical Engineers has asked for papers on the following subjects: The American steam turbine, the American gas engine, the power plant of the tall office building, the American Locomotive testing plant, the American shop management problem and the modern American machine tool.

JAMES WATT MEMORIAL.

A memorial statue is about to be erected in Greenock, Scotland, on the site of the cottage in which James Watt was born. Subscriptions are solicited in many countries, and an American committee has been organized with Andrew Carnegie as chairman. Subscriptions should be sent to Theodore Dwight, secretary and treasurer of the American committee, 99 John street, New York.

EMPLOYMENT BUREAU—CHICAGO & ALTON RAILROAD.—While nearly all railroads employ somewhat systematic methods of recruiting the several branches of the service, thus far only this road has an employment bureau, established with a view of securing recruits from among the young men living along the line of the road. The object of this is to secure the advantage of the home influence and establish an *esprit de corps* because of employing those who are interested in the country to which the road is tributary. This has been worked up into a systematic policy by an employment bureau which is under the direction of Mr. W. A. Freese, superintendent of telegraph. It is confined to the transportation department and is aimed to elevate the standard of employees in every capacity. In order to reach those who might not otherwise apply for positions circulars are issued and distributed in the towns along the road containing instructions for applying for service. All applications are investigated and records made. Civil service rules govern the bureau and the results for the first year have been very successful, 275 men having been selected by examination from a large number of applicants during that period.

LONG SEA TRIP WITH OIL FUEL.—The steamship *Nebraskan* of the American-Hawaiian Line recently arrived in New York after a 12,724-mile (nautical) trip from San Diego, Cal., using oil fuel all the way. The trip was made via the Straits of Magellan in 51 days and 9,300 barrels of oil were consumed. This oil was the crude product of California. By its use, 12 men are saved in the fire room and 3 men only were required for tending the burners.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—Nothing will be inserted in this journal for pay, EXCEPT IN THE ADVERTISING PAGES. The reading pages will contain only such matter as we consider of interest to our readers.

Contributions.—Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.

To Subscribers.—The AMERICAN ENGINEER AND RAILROAD JOURNAL is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied. When a subscriber changes his address he ought to notify this office at once, so that the paper may be sent to the proper destination.

The locomotive is the only thing on a railroad that actually earns money. If 10 per cent. of the number of locomotives are out of service for any reason, that proportion of the earning power is unavailable. If 20 per cent. are in the shops or waiting to get in, the whole system begins to limp. Many roads are limping because of a lack of shop facilities, and shop improvement is to be one of the biggest business questions of the railroads for some time to come.

By sending an annual pass and a personal letter to every station agent on the line, Mr. J. C. Stuart, general manager of the Erie Railroad, has encouraged these important subordinates and has brought them to understand that they are appreciated as necessary factors in successful management. This recognition is as unusual as it is easy of accomplishment and it constitutes an example which others might profitably follow in all departments. Shop and roundhouse foremen, from whom so much is expected, would give "value received" many times over for an annual pass. Doubtless they would not often use one, but the comfort of having one in the pocket would help the superintendent of motive power to secure better service and better foremen. It costs a road nothing to do this sort of thing and the returns cannot be estimated.

The General Manager fell into the ash pit. He was chagrined and solled, and his kid gloves were torn. He had cigars for his friends who happened to hear of it, but the story has been a long time leaking out. It occurred last winter on the occasion of an inspection of the roundhouse with the superintendent of motive power and master mechanic, who were trying to find out why locomotive work was delayed at that particular point, the location of which will not be stated now.

They had not even entered the roundhouse, but were walking toward it in the fog which hung about the building in the still air. This experience was an effective object lesson to this officer, who up to that time had not appreciated the difficult problem of ventilating roundhouses in cold weather, and he had not dreamed of the conditions which render not only the house itself difficult to navigate, but also the surrounding yard. During the past severe winter, fog in roundhouses has been a serious matter, delaying work and making it impossible to do roundhouse repairs properly. Even with the best ventilating facilities the trouble has not been entirely overcome, and the problem is one to be studied with the greatest care by those who are operating under pressure for power. This general manager will be likely to approve more extensive appropriations for roundhouse improvement, and it would be a great help in progress if other managing officers could get a near view of the difficulties.

WHAT ARE YOUR LOCOMOTIVES DOING?

This is a vital question of railroad operation to-day. Upon the answer depends the standing of the management before the owners of the properties and that management is best which shows the best results in this item of performance.

Managements are increasing the average loading of cars, they are eliminating grades, rectifying alignment, strengthening bridges, improving condition of track, increasing terminal facilities, lengthening sidings, improving water stations; they are closely watching the dispatching of trains and providing in every possible way the facilities which will tend to increase the weight of the average train and shorten its time on the road.

It is perfectly clear also to all who have watched the progress of the past five years that the locomotive is appreciated as the important remaining factor in the problem. A degree of attention is now given to the locomotive department which it never received before the ton mile and the heavy train became watch-words. The attention now given to new shops and the expenditures authorized for their construction and equipment indicate a new and promising interest in the motive power side of operation. All the prominent roads are supplying themselves with the most powerful locomotives which their condition will permit of running and locomotive terminals have exhibited signs of increased interest in the form of improved facilities in connection with locomotive operation. But as yet the surface of the locomotive problem has hardly been scratched. In spite of progress made, nothing is seen in the tendencies of the time which gives promise of placing those to whom the locomotive is entrusted in position to meet the extraordinary demands which are to be made upon them.

Nothing short of a fundamental change of policy will meet the locomotive problem of to-day and of the future. This problem is the administration upon a business basis of the motive power of large aggregations of railroads and it is a problem of men and of methods. The men and methods which sufficed for small roads are inadequate to-day and it becomes a vital necessity that the future be provided for.

Nothing short of a representation of the motive power departments in the management will answer. What is needed is an officer of the grade of vice-president or general manager in charge of motive power and he must be a man who "draws enough water" to build up an organization and formulate a plan which will put the locomotive on a business basis and keep it there for the years which are to come. As a type he must be big enough to secure from the directors that which is needed in protection of their own interests and he must have the authority to inaugurate policies of construction, operation and management which will constitute a permanent plan for putting locomotives in position to do what is expected of them. He must do much besides securing good locomotives. He must be able to institute plans for recruiting the service, for elevating the men in the ranks and giving them cause to look to the company as to one interested in their welfare and he must

be able to put motive power work into such a condition as to warrant the best mechanical talent of the country to prepare for high positions of responsibility.

The present large systems require officers for this work, who are equal in ability and authority with the general managers. Is it not sufficient to tax the capabilities of the best railroad man to administer this department, to see that locomotives are such as the conditions require, to see that shops and terminal facilities are right, to know that shops are equipped and operated in accordance with the best commercial business principles, to know that locomotives are operated efficiently and economically and to build up an organization which will carry all these along and provide for its own recruits—is not all this enough, on a large system, to require the exclusive attention of the best business man and executive in the service?

In addition to all this it is to-day necessary, and in the future will be more so, to manage the department so that the grievance committee will lose some of its importance. This will require a most carefully considered and definite policy which will disarm those who make the most of opportunities to widen the gaps between the men and their employers.

Not until the railroads fully appreciate the necessity for establishing large motive power policies and work them out on a long term basis will the question, "What are your locomotives doing?" be satisfactorily answered.

The "lightning changes" or earthquakes of management which seem to be a part of current progress must soon give way to a situation of permanence, and the efforts to make brilliant records must give way to steadiness of operating methods. Nothing can succeed under chaotic methods, such as those which have involved revolutionary changes in the entire organizations of several large systems in the space of two years. When the smoke of these battles clears away the subject of these paragraphs should receive attention, and those who have and those who have not had the battles should calmly enter into a plan for elevating the motive power administration to the high plane on which true business policy places it.

ROUNDHOUSE VENTILATION.

No winter in recent years has brought out the deficiencies of roundhouses as the one from which we have just emerged. The severe weather conditions necessitated an unusual amount of roundhouse work on locomotives and they also made the work unusually difficult. A fortunate result is to attract attention to the importance of the best roundhouse facilities as affecting the movements of trains.

Even in the best equipped and best ventilated houses the fog occasioned by condensation of moisture in the air seriously hampered those who were responsible for running repairs. This was not alone confined to the house itself, but in cold, windless days, the fog over the turntables occasioned more than one "engine in the pit" and was a serious matter.

This points to several things. It is necessary to keep down the moisture by blowing engines down into closed systems of piping and to maintain dry floors by good methods of drainage; to take the smoke out of the house through the jacks and ventilators and to install ventilating machinery, which will clear the unavoidable fog away. An exhauster system of removing the smoke may be necessary, but the best plan seems to be to use the fan system of distributing warmed air all over the house and supply it in quantities sufficient to do the work.

One of the most recently constructed roundhouses which has a thoroughly up-to-date fan heating system which changes the air completely every 15 minutes, was exceedingly foggy last winter. This roundhouse was provided with one square foot of heater piping for every 120 cubic feet of volume of air in the building, but this liberal supply did not prove to be enough. It would be well to try more heating surface and fans of sufficient capacity to change the air every five minutes. Whatever the cost, roundhouses should be made safe and comfortable for the important work which must be done in them.

A return to direct heating by steam coils in the pits has been

suggested, but this must always be less efficient than the fan system, which will at the same time heat and ventilate the house. It is a fact that the worst offenders are roundhouses with low roofs, which seems to point to the desirability of supplying more air space vertically. If the writer had the responsibility of a lot of roundhouses he would take some of the best experts in ventilation into his confidence in this problem. It surely is a question the solution of which will tax the best authorities.

NOTES ON A TRIP THROUGH OLD MEXICO.

BY G. E. HENDERSON.

A trip over the Mexican Central Railway in summer time is particularly enjoyable. Popular opinion considers Mexico a hot country and one to be visited in the winter only. While this is true as far as the Gulf cities are concerned, it must be remembered that the Republic is principally a great table land varying from 4,000 to 10,000 feet above sea level. If we consider a transverse section of the country from Tampico to Manzanillo, from the Gulf to the Pacific, we have a stretch of about 500 miles, of which 100 miles on the Gulf Coast and 50 on the West Coast have less than 1,500 feet elevation; the remainder is mostly above 5,000 feet. The Mexican Central operates about 3,000 miles of road, and only about 600 miles have an altitude of less than 1,500 feet.

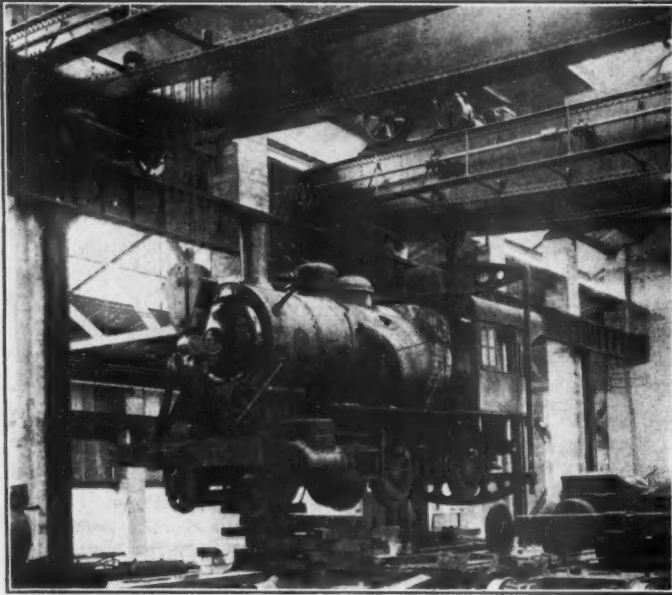
Starting with Juarez, on the Rio Grande, 3,717 feet above sea level, the first town of any size which we reach is Chihuahua, 225 miles distant (at an elevation of 4,643 feet), after passing through an undulating country. At this point quite large shops are located for locomotive and car repairs. Ortiz, 50 miles further south, is the nearest station to the new Boer colony, which is being founded by General Snyman. Already there are a dozen Boer families on the ground and 50 more are expected shortly. They have had a territory of 83,000 acres set aside for them contiguous to the Rio Conchos and the Boers are very enthusiastic over their new home. The arrangements with the Mexican government have been carried out by General Snyman, through whose efforts the plan has been successfully launched. He states that the Boers will at once accept Mexican citizenship, and we think that both the Boers and Mexico are to be congratulated upon this admirable arrangement.

Continuing southward we reach Torreon, 518 miles from Juarez, at which point the Mexican International makes connection. The elevation here is about the same as Juarez, but we now commence to climb to the highest point on the main line, Zacatecas, 8,044 feet above sea level, and 780 miles from Juarez. The grade near the summit is $1\frac{1}{2}$ per cent. and sharp curves continually reversing were needed to keep the grade down to the amount named. As we pass the summit we look down upon the town, which is very picturesque from the rail road. One hundred and twenty miles further south is Aguas Calientes, so named from the thermal springs, around which are clustered several banos, or bath houses. This point is the junction of the Tampico line, although the branch actually leaves the main line at Chicolate, eight miles to the north. At this point the new shops of the Mexican Central are now being completed, to which reference will be made later.

The next important town is Irapuato, 1,005 miles from Juarez, from which point a branch runs to Guadalajara and a short distance beyond. This latter city is 5,054 feet above the sea and is only 125 miles from the Pacific in a direct line, but as yet has no rail communication to the sea. The city is lighted by electricity generated by water power at the falls of Juanacatlan, 20 miles to the east. This installation is quite modern, the alternating current generators having been supplied by the General Electric Company and are driven by rope cables from horizontal turbines.

From Irapuato the main line is practically level until we reach San Juan del Rio, and we then pass over two summits before

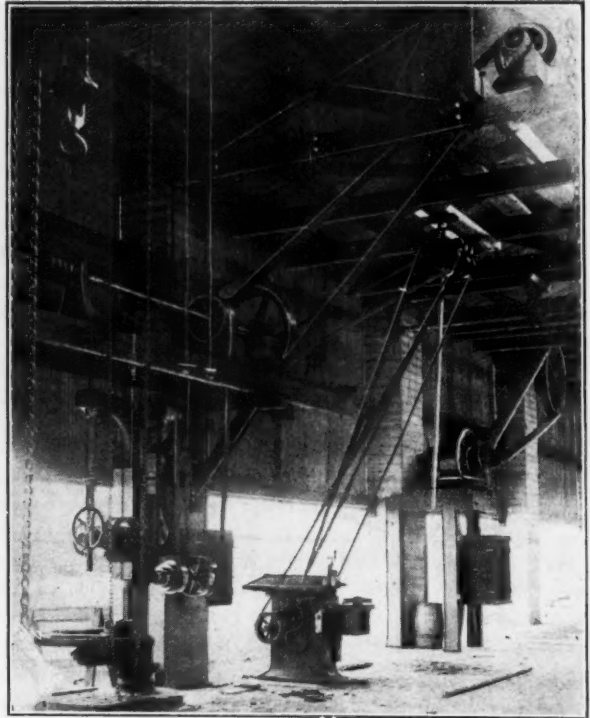
reaching Mexico City, 1,224 miles from Juarez and 7,350 feet in altitude. The country north of Irapuato resembles New Mexico and Arizona, but south of that point is exceedingly fertile and well watered. The Guadalajara branch also runs through a fine agricultural section. Most of the engines on this branch burn wood, as also on the Cuernavaca branch. This wood is mostly the root of the mesquite, which grows abundantly and which, while being very light wood above ground, has roots from 4 to 8 inches in diameter. Coal is quoted as worth \$20 a ton Mexican, and wood probably \$8 a cord.



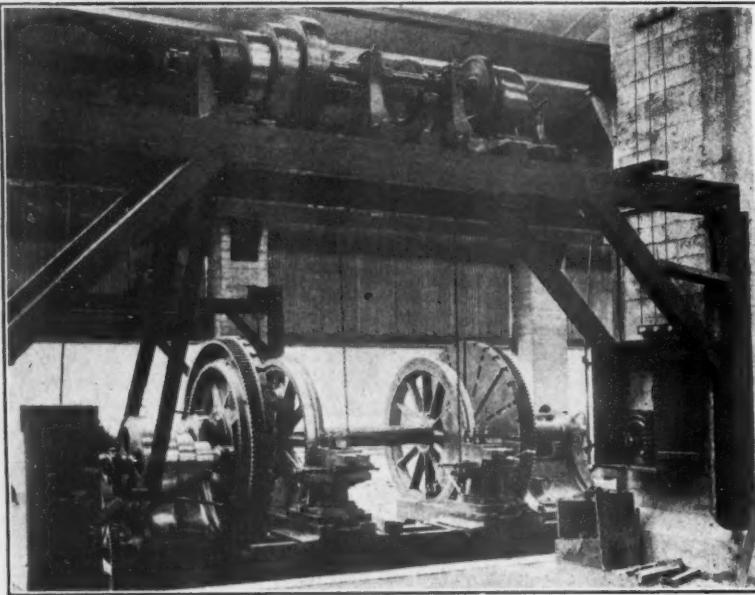
TWO NILES 60-TON CRANES IN THE ERECTING SHOP.

the property. This is composed of adobe with brick pilasters and coping, and is about 12 feet high. It is intended more to prevent articles from being stolen than to guard against strikes.

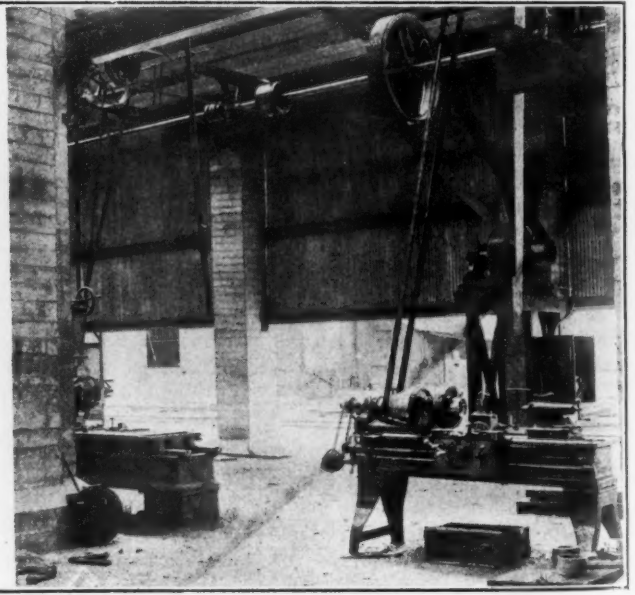
The first building which you meet is a 12-stall roundhouse about 75 feet length per stall, the walls being formed of concrete and the roof of wood laid flat on joist, supported by two posts between each track. There are fixed wooden smoke jacks over



LOCATION OF GROUP MOTORS IN THE MACHINE SHOP.



MOTOR DRIVE FOR A WHEEL LATHE.



GROUP MOTOR IN MACHINE SHOP.

AGUAS CALIENTES SHOPS—MEXICAN CENTRAL RAILROAD.

The company is at present maintaining repair shops at Chihuahua, San Luis Potosi, Guadalajara, Cuernavaca and Mexico City, the latter being the principal shop of the road and where the heaviest work is done. These shops, however, are old and have been added from time to time, until quite a heterogeneous collection of buildings and sheds comprise the present outfit. Besides, the motive power has been added to until the shops are inadequate, so that some years ago it was decided to erect new shops at Aguas Calientes, which is a much more central point for the system. The new Aguas Calientes shops are located immediately north of the station, and the first thing that impresses the visitor is the substantial wall surrounding

each pit. The floor of the pits is of brick rounded, but a dirt floor is used in the house. There are no doors, and in place of the usual windows in the outside wall there are arched openings about 8 ft. wide and 12 ft. high, with iron gratings. Just below the eaves there is a series of openings about 12 ins. wide and high extending along the outside and end walls for ventilation. The roof slopes towards the table and has drain pipes inside the inner circle posts.

The erecting and machine shop is 380 ft. long by 132 ft. wide. The center section is about 68 ft. in the clear and has three longitudinal tracks, 22 ft. centers, with pits 4 ft. deep extending the complete length of the shop. The posts sup-

porting the roof are of concrete 3 ft. square on 20-ft. centers. The roof covering is galvanized corrugated iron with a 3-ft. vertical opening between the center and side roofs. Iron sheathing extends from the side eaves to within 8 ft. of the ground and the gable ends are of concrete throughout. A 12-ft. strip of skylight is placed on each side of the ridge of the roof.

The erecting portion is spanned by two 60-ton Niles electric cranes, and the machine section on one side by a 5-ton, and on the other side by two 5-ton electric cranes. While the large cranes traverse the whole length of the shop the small ones have a traverse of 240 ft. only. The main crane girders are supported by steel posts, anchored to the concrete piers. The side crane girders rest upon cast iron brackets bolted to the piers.

The machinery will be driven by electric motors supported 8 ft. above the floor by wooden frames resting on concrete foundations. The drives will be both group and individual. The cranes and motors are in place, the motors being wound for 500 volts. The machinery has concrete foundations. Most of the machinery has been moved from Mexico City. The shafting timbers are supported by bolts and clamps, applied diagonally so that the lower timbers can be moved in either direction for final adjustment. A tool room about 20 x 60 ft. is provided in one of the side bays. A brick floor is used in the erecting portion. Like the roundhouse, there are no doors or windows in this shop except in the tool room. The smith shop is 63 x 200 ft. and is of same style of construction as the machine shop, but has only one span of roof. The equipment includes several large hammers and heating furnaces.

The power house is perhaps the most interesting of the several buildings. Three 250-horse power Babcock & Wilcox boilers provide steam at 200 pounds pressure. These are to be hand-fired, as labor is cheap, 50 cents Mexican (about 22 cents United States) being the ordinary rates per day for such labor. Draft is induced by the Sturtevant fan system, and it is intended later on to provide an economizer. A Wheeler feed water heater has been set up in the meantime. Electric current for light and power is generated by three DeLaval turbines with Milwaukee electric dynamos. The turbines are of 300 horse-power, each operating two generators of 250 volts potential. The three-wire system is used, thus obtaining 500 volts for power and 250 for lights, all being direct current. The turbines are guaranteed to deliver power at less than 14 pounds of steam per horse-power hour. The turbines run at 9,000 and the armatures at 900 revolutions per minute. It is intended to use a condenser, of the surface type, a cooling tower being used for supplying the necessary cooling water. A Laidlaw-Dunn-Gordon compound, duplex air compressor is in place, having a capacity of 800 cu. ft. free air per minute at sea level. A 10-ton hand crane covers the entire area of the engine room.

The entire installation, both electrical and mechanical, and for the shops as well as for the power plant, was made by the D'Olier Engineering Company, Philadelphia, Pa.

The Mexican Central has made their castings for many years at Mexico City, but this will now be done at "Aguas" (as it is called familiarly), in a building or shed 60 x 216 ft., one 5 and one 8 ton cupola being used for the purpose. This building is now under way and is merely a galvanized roof on concrete piers.

The brass foundry is a brick and adobe building 40 x 80 ft., and is entirely enclosed with walls, differing in this respect from the other structures. The pilasters and trimmings are of brick and the panels of adobe, which makes a very neat structure. There are six furnaces for crucibles in this foundry, with hoists for moving the pots of melted brass.

The planing mill is of the open shed-like construction already described and is 70 x 200 ft. It is also driven electrically. The passenger car paint shop is 130 x 300 ft., and is of brick and adobe (like the brass foundry), but it has a saw-tooth roof construction.

The railway company has a mill for rolling scrap iron, etc., at San Luis Potosi, and this is to be moved to Aguas; the piers

for this building, which will be 60 x 108 ft., are up, but the roof has not been applied. A pattern shop and house with fireproof adobe walls between each section provides for this work. A fine brick and adobe storehouse and an oil house of same construction completes the buildings, with the exception of an all-brick office, which is in course of erection. It is expected, however, to erect in the near future, a tank shop 48 x 300 ft., a wheel foundry 60 x 144 ft., a wheel and axle shop 40 x 100 ft. and a coach repair shop 130 x 300 ft.

The employees themselves have not been forgotten in the general scheme. A large brick hospital has been constructed as well as a home for the superintendent of machinery and master mechanic. There are also 30 single and 16 double cottages of brick and adobe which will be rented at \$10 and \$20 per month (Mexican) respectively for the mechanics, and several long rows of adobe huts with a central patio for the laborers.

The whole plant seems to have been admirably planned, and the buildings are well adapted to the climate, which is always moderate, but it seems as if larger structures will soon be needed. There is ample room, however, for extensions. Mr. Ben Johnson, superintendent of machinery, directed the installation.

EDITOR'S NOTE.—Mr. Henderson's notes have been in type for a number of months, awaiting further information concerning the Aguas Calientes shops. Through the D'Olier Engineering Company of Philadelphia this information has been supplied, including the photographs from which these engravings were made.

GOOD TESTIMONY FOR PIECE WORK.

Of all the changes made by the general officers of the company since I have been with the Central Railroad of New Jersey, none has been so mutually satisfactory and financially gratifying to employers and employees in the car-shop department as the introduction of the piece-work system in 1893. Our books and records show as absolutely correct that:

(1) Average time consumed by repairs to our passenger, freight, and coal car equipment is cut down about 35 per cent. This means that the cars instead of being at an average of three days out of service per year for repairs, they are out of service only two days, and the whole equipment earns money one additional day per year.

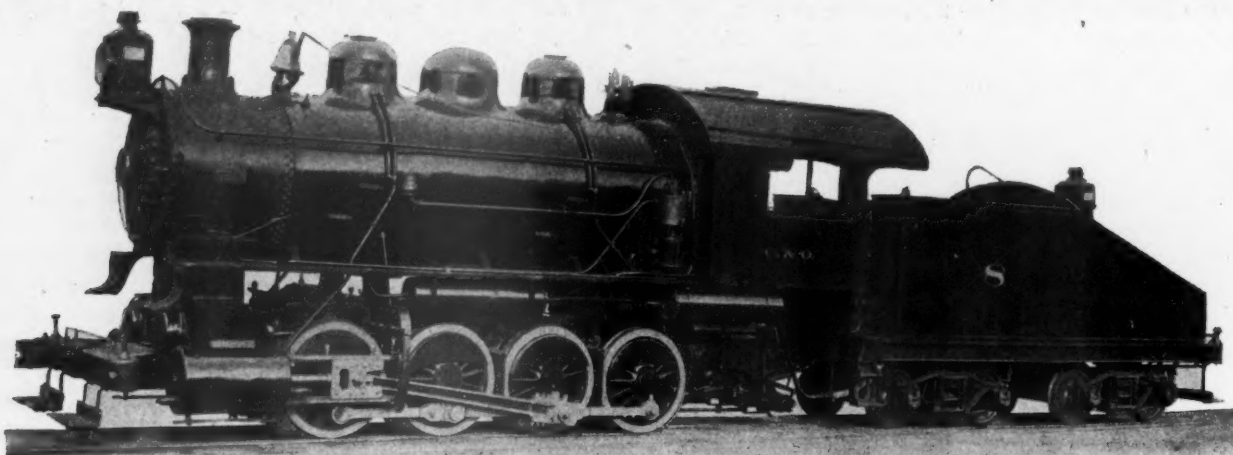
(2) That total cost of labor repairs to passenger, freight and coal cars has decreased at least 27 per cent. when compared with cost of labor done by day work.

(3) That average rate of pay per man, worked under existing piece-work prices, has increased from 17.5 cents to 22 and 23 cents, or equivalent to a raise of 25 per cent. per hour worked.

(4) All department foremen must be in full charge of their men and be responsible for maintaining good discipline, and keep up the standard of efficiency. They should be made acquainted with and be held accountable for, to a certain degree, the labor and material cost of cars repaired by them or material manufactured. They should be always on the look-out for cheapening cost of labor or articles manufactured by the introduction of new methods or modern tools, but not resort to cutting prices.

(5) That willing co-operation is a great helpmate. That overlooking personal shortcomings, common in one form or another to everybody, makes friends. That the curbing of "I" will be appreciated by all concerned and produce genuine admiration for acts deserving them.

Where these points, mentioned as essential for the economic management of car shops, are applied (enforced firmly but intelligently and humanely), to a shop organization, the fundamental principles of effective organization and economic management for car shops have been put into practice and will reduce on any railroad the total expenditure for maintenance of car equipment from 1½ to 3 per cent.—*Chas. Streicher, before the Pacific Coast Railway Club.*



CHESAPEAKE & OHIO RAILWAY.

HEAVY EIGHT COUPLED SWITCHING LOCOMOTIVE.

AMERICAN LOCOMOTIVE COMPANY, Builders.

EIGHT COUPLED SWITCHING LOCOMOTIVE.

CHESAPEAKE & OHIO RAILROAD.

Unless built for transfer purposes where heavy trains are to be hauled through comparatively long distances, a switching locomotive weighing 171,175 lbs. is seldom seen in the equipment of a railroad. This engine has eight coupled wheels and gives a tractive effort of 41,200 lbs. It was designed and built by the American Locomotive Company at the Richmond works, and is an example of advance in switching locomotives made necessary by the increasing capacity of road locomotives which renders an ordinary light switch engine incapable of the quick work which has become necessary in the yards. This locomotive has an enormous heating surface for this service and is capable of handling very heavy trains for short distances. It has a 68-in. boiler, piston valves with inside admission, a moderately wide firebox and an extended wagon top boiler. Mr. J. F. Walsh, superintendent of motive power of this road, states that this powerful engine is required for switching service at the yards at Clifton Forge, Va., where there is a heavy grade coming into the yard. The 22 by 28-in. consolidation engines bring trains in from the West which are too heavy for an ordinary switch engine to handle, necessitating cutting trains into three pieces. This engine is intended to handle the heaviest trains that the road engines can pull up to the yard. The following list gives the principal dimensions:

EIGHT-WHEEL SWITCHING LOCOMOTIVE—CHESAPEAKE & OHIO RAILROAD.

GENERAL DIMENSIONS.

Gauge	4 ft. 9 ins.
Fuel	Bituminous coal
Weight in working order	171,175 lbs.
Weight on drivers	171,175 lbs.
Weight engine and tender in working order	292,335 lbs.
Wheel base	13 ft. 7 1/2 ins.
Wheel base, total, engine and tender	45 ft. 7 3/4 ins.

CYLINDERS.

Diameter of cylinders	21 ins.
Stroke of piston	28 ins.
Horizontal thickness of piston	6 ins.
Diameter of piston rod	4 ins.
Size of steam ports	1 1/2 ins.
Size of exhaust ports	2 1/2 ins.
Size of bridges	1 1/2 ins.

VALVES.

Kind of slide valves	Piston type
Greatest travel of slide valves	5 1/2 ins.
Outside lap of slide valves	1 in.

WHEELS, ETC.

Number of driving wheels	8
Diameter of driving wheels outside of tire	51 ins.
Thickness of tire	3 1/2 ins.
Diameter and length of driving journals:	
9 and 9 1/2 ins. diameter x 10 ins. long	
Diameter and length of main crankpin journals:	
7 ins. diameter x 6 1/2 ins. long	
Diameter and length of side-rod crankpin journals:	
7 1/4 ins. diameter x 5 3-16 ins.	

BOILER.

Style	Extended wagon top, wide firebox
Outside diameter of first ring	67 ins.
Working pressure	200 lbs.
Thickness of plates in barrel and outside of firebox	9-16, 11-16, 3/8 in.
Firebox, length	80 ins.

Firebox, width	70 ins.
Firebox, depth	Front, 70 ins.; back, 67 ins.
Firebox plates, thickness:	
Sides, 3/8 in.; back, 3/8 in.; crown, 3/8 in.; tube sheet, 1/2 in.	
Firebox, water space	Front, 4 ins.; sides, 4 ins.; back, 4 ins.
Firebox, crown staying	Radial, 1 1/8 ins. diameter
Firebox, staybolts, diameter	1 in.
Tubes, number	351
Tubes, diameter	2 ins.
Tubes, length over tube sheets	14 ft.
Heating surface, tubes	2,572.97 sq. ft.
Heating surface, firebox	132.13 sq. ft.
Heating surface, total	2,705.10 sq. ft.
Grate surface	3,888 sq. ft.
Exhaust nozzles, diameter	5 1/4 ins.
Smokestack, inside diameter	16 ins.
Smokestack, top above rail	14 ft. 10 1/2 ins.

TENDER.

Weight, empty	52,400 lbs.
Wheels, number	8
Wheels, diameter	33 ins.
Journals, diameter and length	5 1/2 ins. diameter x 10 ins.
Wheel base	18 ft. 1 in.
Water capacity	6,000 U. S. gals.
Coal capacity	7 tons

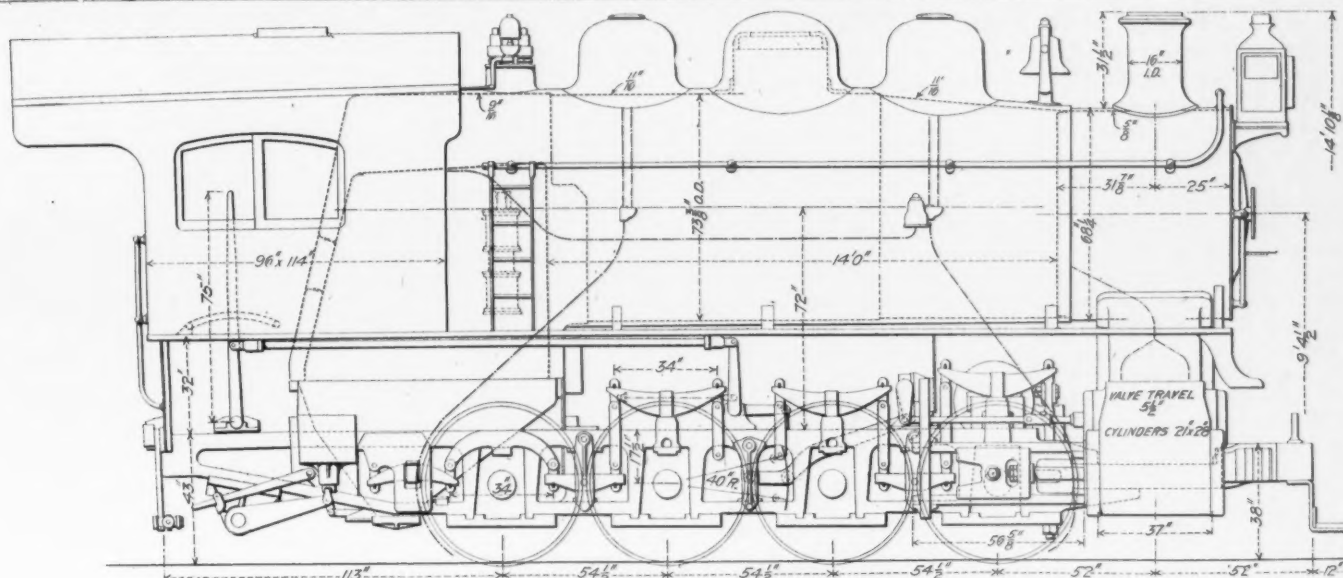
STEAM TURBINE POWER PLANT FOR BOSTON NAVY YARD.

An interesting departure in engineering practice by the authorities of the United States Navy, Department of Yards and Docks, is marked by the introduction of Westinghouse-Parsons steam turbines for furnishing power for lighting the buildings and yards, and power for operating dry dock pumps and miscellaneous machinery.

The initial installation for this character is in process of construction at the Charlestown Navy Yard, Boston, Mass., and for the present one Westinghouse-Parsons turbine generating unit of 750-kw. capacity will be placed in service. This turbine will be of the short-barreled type and is now under construction at Pittsburgh. A Worthington surface condenser will be employed, using salt water for circulation. The condensers will be located between the foundations, which consist of concrete piers. A running vacuum of 28 ins. will be secured through the aid of a dry air pump. Steam will be furnished at 150 lbs. pressure by Babcock & Wilcox boilers in units of 350 h.p., equipped with Roney mechanical stokers. Coil superheaters in the boiler settings will furnish to the turbine a superheat of about 100 deg. F. The boiler house will be equipped with a complete outfit of coal and ash-handling machinery.

The turbine plant will supply 3-phase alternating current at 2,300 volts, this voltage being used for general distribution and for direct use in larger motors, while for lighting lower voltage will be provided by transformation. The turbine generator will be served by a 37 1/2-kw. Westinghouse compound exciter unit.

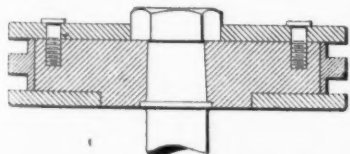
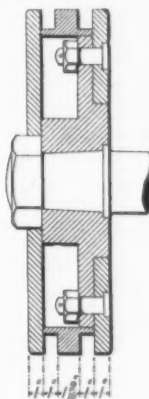
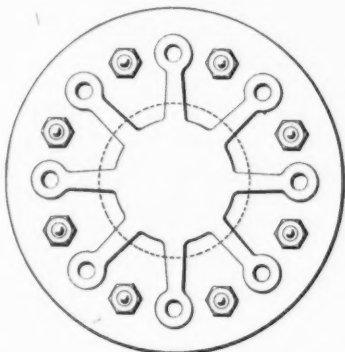
The engineering work is under joint execution by the Department of Yards and Docks and the constructing engineers, Westinghouse, Church, Kerr & Company, who are installing the plant.



HEAVY 8-COUPLED SWITCHING LOCOMOTIVE.
CHESAPEAKE & OHIO RAILWAY.

THE SEITZ BUILT UP PISTON.

A method of constructing locomotive pistons devised by Mr. Charles Seitz is illustrated by the accompanying engraving made from a drawing received from Mr. J. D. Young, machine shop foreman of the Burlington & Missouri River Railroad at Havelock, Neb. This piston originated with Mr. Seitz, who devised it with a view of increasing the life and reducing the cost of repairs to pistons. He has been employed for 15 years on pistons as a machinist and has given the subject a great deal of study, with a view of constructing a built-up piston which will last the full life of the rod and not require replacement by a new one as the cylinder becomes worn, necessitating re-boring. This construction is very simple and the slight cost



THE SEITZ BUILT-UP PISTON.

of renewal to fit a worn cylinder must appeal to everyone connected with locomotive repair work. Should a cylinder require re-boring it is not necessary to remove this spider from the rod and replace it with a new one of sufficient diameter to fill the cylinder. By simply removing the follower plates and replacing them with new ones and putting in a new skeleton ring, the piston is ready for replacement and is practically a new head, fitting the new sized bore of the cylinder. This is done at less than one-fourth of the cost of labor and material necessary for repairing an ordinary piston. The AMERICAN ENGINEER believes that there are many earnest, wide-awake

machinists and others in railroad shops who are well informed on these subjects and who have good devices of this kind which readers will be glad to know about.

THE POWER REQUIRED IN PLANER DRIVING.

An interesting series of tests were recently made with a motor-driven planer at the works of the Fred M. Prescott Steam Pump Company, the results of which are of importance for their bearing upon the important subject of driving metal planers. The planer used was a 48-in. planer, with 12 ft. bed, built by the Gray Planer Company, which is equipped for individual driving with a type B-10, 220-volt compound-wound direct-current motor, built by the Milwaukee Electric Company. This motor is of 15-h.p. capacity, operating normally at 1,100 rev. per min., and is arranged for variable speeds by field control; a Cutler-Hammer field regulator is used for varying the field's strength with a view to increasing the speed of the machine for various kinds of work.

A number of readings were taken with the planer operating at different cutting speeds, in each of which cases three tools were used, cutting simultaneously; two of the tools were set for a $\frac{3}{8}$ -in. cut and the other tool for a $\frac{5}{8}$ -in. cut, and the feed of each was 1-16-in. The following table shows the current required by the motor for the different speeds of the planer from 20 ft. up to 26 ft. per minute:

Cutting Speed (Ft.).	Motor Speed.	Amperes During Cut.	External Resistance; Ohms in Shunt-Field Coil.	Amperes During Reverse.
20	1170	23.5	0	62
21	1210	24	15	60
22	1270	24.5	46	59
23	1330	25.5	65	58
24	1390	26.5	97	57
25	1450	27.5	125	57
26	1510	28.75	148	56.5

The voltage of the circuit upon which the motor was operated remained constant at 230 volts throughout the series of tests.

Particular attention should be given to the variation of current required by the motor. When the planer was operated at a cutting speed of 20 ft. per minute the motor required a rush of current, amounting to 62 amperes for the reversal from cut to return, while when running at the increased speed of 26 ft. per minute the extra current required at reversal had dropped to 56½ amperes. This indicates that it is not only practical but economical to use the field control method of increasing the speed of a motor drive upon a planer. This method of increasing the shunt-field resistance resulted in this case in a material reduction of the current required by the motor at reversals.

We are indebted to Mr. F. W. Cox, superintendent of the Milwaukee Electric Company, for this information.

LETTERS TO THE EDITOR.

COMMERCIAL CONDITIONS IN RAILROAD SHOPS.

To the Editor:

Seventeen years of shop experience have convinced the writer that the success of the modern manufacturing industries depends greatly on their ability to perfect labor-saving devices to cheapen the output of each of their different departments. Up-to-date managers and superintendents of manufacturing concerns are alive to this vital point, and see to it that they have at the heads of their various departments, and particularly in the case of their tool department, the very best man that it is possible for them to secure for the work.

As a general thing, railroad shops do not devote much attention to the tool-making question, as private concerns of similar character do. This is due in a great measure to the fact that, in the words of a well-known superintendent of motive power, the railroads "are in the transportation business and not in the manufacturing business." While this may be to a certain extent true, it does not justify the utter disregard of the tool department that some railroads seem to have. It is not the intention to cast any reflection on any member of the great family of railroad officials, but it is nevertheless a lamentable fact that in the majority of cases the toolroom is given but scant attention. In fact, there are cases, known to the writer, of good-sized railroad shops, employing as high as fifty full-pay machinists, which have absolutely no toolroom whatever; the only approach to a toolroom is possibly a wrench-rack in some out-of-the-way corner, and what few special tools each individual machinist can keep in his own locker—although the more he can steal from another man the more he will have for his own. There can be no denying the fact that work done in shops of this sort must of necessity be done in the crudest manner possible, with accompanying disadvantages to the motive-power equipment and output.

It is not to be insinuated that the machine shops of our railroads of to-day are not in charge of capable men; the fact is, some of as good shop managers as can be found anywhere in the country are in charge of our railroad shops, but a great number of them have been brought up along railroad lines exclusively, and they unconsciously see things from the older railroad point of view only. The effect of this condition of affairs may be seen by considering a few specific cases in the machine shop:

For instance, it would never take a lathe man three hours to bolt a crosshead to a face-plate on a lathe and rebore it for a pin fit if the shop had a full equipment of standard piston fit and cross-head reamers.

It would not take one hour to tap out eccentrics by hand if the shop had an automatic tapping device to tap them in the drill press, by which the work could be done in five minutes.

It would not take four hours to bend the arm of a tumbling shaft and then swing it in the lathe to be able to turn the bearings if they had a tumbling-shaft turning device to do the work.

In place of taking eighteen hours to plane ten eccentric halves by bolting on the planer bed, thirty of them ought to be done in ten hours with a special eccentric-planing jig.

It would not take two hours with a bar and cutters on a drill press to true out knuckle-pin bearings if the shop had reamers with which the same work could be done in fifteen minutes and a standard hole made.

Where it would take one hour to turn a driving brass with an old-style flange and nut mandrel, three of them could be done in the same time by using a mandrel with set-screws to locate them in position, and thus not require truing up, and cupped set-screws to hold them tight.

A special chuck for shoes and wedges, whereby the work could have all the benefit of all the heads on a planer at once, would be the means of reducing the time by at least one-half over the method of using only one head at a time.

It would not take one hour to cut off a set of piston packing rings if the shop had a gang cutter, whereby the same work could be done in ten minutes.

These are but a few examples of the many cases that could be cited from actual experience to show the difference between a shop with an equipment of modern tools and one in which the toolroom end is not given the fullest attention. A closer standardizing of parts, made possible by complete sets of reamers, drilling-jigs, templates, etc., for certain lines of work, such as rod knuckle-joint pins, crosshead pins, etc., would be the means of removing an immense amount of extra labor, time, worry and inconvenience, to say nothing of the great reduction of maintenance.

It is possible to replace a broken part of a bicycle, automobile,

typewriter, etc., of any of the standard makes, by simply sending to the factory and specifying only the number and names of the parts required. Why should not this be true, to a great extent, also, of locomotives? Just imagine the great saving it would bring about, and resulting improvement in all departments, if any roundhouse foreman along the line were able to send to headquarters for any broken part and know for a certainty that it could be applied without many hours of fitting?

The question is, however, How can this state of affairs be best brought about? In the first place, a complete set of jigs and templates should be kept on hand by the toolroom foreman for all vital parts of the running gear, rods, etc., that are more liable to become broken or thrown out of place—by this effort, duplicate parts are made possible. Then an accurate record should be kept of all of these; they should be catalogued, indexed, and filed in such a manner as to render it possible for any one, even a stranger, to walk into the toolroom and find easily and quickly anything he might want in this line. When new classes of engines are bought it should be the toolroom foreman's duty to see that the equipment of jigs is brought right up to date for all these new appliances.

With an accurate and complete set of jigs and templates, duplicate parts could always be kept on order. This is the main point—to be able to furnish the parts. The application is of secondary importance. In order to do this with the greatest hope of success, however, the scope of the toolroom should be enlarged. It should not only embrace the making and keeping of labor-saving devices, standard measuring tools, etc., but under its jurisdiction should come the tempering, drawing, hardening, annealing, etc., of all the drills, taps, reamers, etc., that are needed in this department.

This should be so for the reason that it is much easier and far more certain for the man who has watched and worked up a piece of steel, from the rough forging to the finished article, to be able to tell how it will set in the fire than it is for the man at the fire who has had no chance to observe the peculiar properties of this certain piece through its different stages of transformation. This is not idle talk or mere theory, for it is an established fact that even among the same makes of steel there is always a certain amount of variation as to its action and development. Each individual tool has to be handled as a separate and distinct piece to get the very best results, and the only sure way to tell accurately how to handle it is to watch it closely from the start to the finish.

As far as possible, all manufactured parts should be made in one place, presumably at the largest and best equipped plant on the system. This would enable one set of jigs and standards to do all the work, and thereby do away with the greater or less liability of mistakes. It is not possible, however, to do this in all things, and duplicate sets of jigs should thus be kept at the most important points. This would require a man to look after these equipments and see that they were kept exactly the same at all points, something in the same manner that all the manufacturing concerns in the country keep up their gauges. They, as a rule, have a man or a number of men who do nothing else but see that the gauges are kept to an accurate standard; in fact, they have this work systematized to such a point that in many of them the temperature of the gauge-room is never allowed to vary from one year's end to another.

There is no necessity of this, however, on a railway system, in general repair work, as this work does not require anything like this degree of accuracy. This work can be done by some one in connection with other work. A good, all-round practical man would fill the bill, whose duty it would be to see that these templates, jigs, etc., not only are kept up to an absolute standard, but that they were used in shop practice to the best advantage. He should, in fact, be a man who could not only maintain and apply these ideas, but could also create and develop new ones as the occasion required.

In connection with this work, he could see that the tool steels are handled to the best advantage, not only in the actual use on the machine, but in the storing, keeping, checking, tempering, grinding, etc. The writer has been in shops where a special high-speed steel was being used that cost 70 cents a pound, and the shop was not getting any better results than they were when using the old carbon steels. This was due simply to the fact that there was no one there whose particular duty it was to look after this; some of the men in charge did not know and some did not care, and so the thing went on, with no good results for any one, and only added expense to the company.

In this connection, the question can be asked, and very properly, too: Of what use is an up-to-date tool system if it is not kept up? I can answer emphatically—None! But another question can also be asked, and that is: What reason is there that it *cannot* be kept up? And the answer is, also—None! The only thing that needs a remedy, and, in fact, the only weak spot possible in a

modern and up-to-date tool system, is lack of interest or lack of knowledge among those directly connected with it.

The writer is inclined to the belief that lack of knowledge is more nearly correct, and for this reason: It is admitted by all interested that in the last decade no such remarkable change of shop methods and appliances has been brought about by any one movement as by the introduction of the new high-speed steels. The changes are so great and so many that it is impossible for the best of foremen, let alone the average of the rank and file, to keep pace with the movement and see that everything is keyed up to the point where it is possible to always obtain the best results. In the present every-day run of railroad life, a master mechanic, a general foreman, or even a machine shop foreman, has entirely too much to look after to allow him to devote sufficient time to the tool or steel end of his department.

What is needed to overcome this difficulty is a demonstrator or teacher, a man who not only possesses the necessary knowledge, but also the ability to impart it. This man should work hand-in-hand with the tool man, and it should be his duty to see that all new tools are thoroughly understood by everybody who will be called upon to use them. He should go from shop to shop as any new tools were introduced and see that they were worked at all times to the best advantage. He should see that the best methods are adopted for tempering, handling and applying all steels, and that all tools are kept up to the proper capacity.

Without going into more elaborate detail, and without touching on one of the greatest of all the problems, *labor*, I can say without fear of contradiction that the above fairly well covers the ground of the many improvements that could be inaugurated by advancing the tool end of a railroad shop in comparison to that of a manufacturing concern.

Widen the scope of each toolroom locally till it embraces everything that properly belongs to its department; then see that the tools along the line are kept checked up together; and the results will be beyond the most sanguine expectations. The motive power will be brought nearer a universal standard; the working method of the entire system, as far as the shops are concerned, will be placed on a sure and accurate basis, and the saving thereby brought about will, I feel certain, be far greater than can be possible in any particular line of shop practice.

H. W. JACOBS,

Union Pacific Railroad, Omaha Shops.

Omaha, Neb.

THE OLD MACHINE TOOLS—MOTOR-DRIVING.

To the Editor:

I note with interest your remarks in the March issue of this journal regarding the work that is being done by some old tools. So much has been said about the demand for new and stronger machines that will be able to stand the strains put upon them by using improved steel and under improved management that in some shops the problem of how to get the most out of the old tools seems to be a greater one than it really is. The best way to solve the problem is to study each machine as to its capacity and give to it such work as it will readily take care of. Much of the work done does not need a more powerful machine, but a faster one. It will be found in many cases that a machine needs only to be speeded faster, which can, in the case of a lathe, be readily done by increasing the speed of the countershaft.

Contrary to the opinion of some, most lathes have not speeds enough to suit the work done upon them. Where this is the case the reversing belt to the countershaft can be changed to give a forward motion, and in that way the available number of speeds will be increased. A case in point: A 24-in. lathe in a certain shop was so speeded that a 3-in. shaft could be turned at a cutting speed of only 30 ft. per minute. Mr. Push came in one morning with a pocketful of "purple-cut" tool steel, and in order to get the benefit of this it was necessary to double the speed of the lathe. The old machine now does the work at a cutting speed of 60 ft. per minute, and the chips come off so hot that visitors light cigarettes from them. Of course, the machine springs considerably under the heavy first cut, but it carries a second and lighter cut all right, and leaves a good surface for the grinder to finish.

In some places the old tools can be used for rough machining only, leaving the finishing to be done in a more substantial machine; and there are cases, of course, where, in order to remove a large amount of metal left by forging, a heavy and powerful tool is needed. One shop had a strong, heavy lathe for doing certain machining work, but could not turn out all that was needed. An old discarded lathe was put back in service and used for roughing

the work handled upon the heavier lathe. The writer saw the machine at work upon a forging 9 ins. in diameter, taking a cut $\frac{1}{2}$ in. deep, with a feed of 1-16 in., at the high cutting rate of 62 ft. per minute. In this case only the roughing was done on the old machine, as it was too badly worn to do accurate finishing.

Some old lathes are doing better work than formerly by being motor-driven. With some methods of motor connection, however, the range of speeds is no better than with the old belt and cone pulleys, but by properly adapting the motor speed-regulating apparatus to a more or less limited variation of diameters, and by giving the lathe such work as will come within the proper range, it is surprising how much more work can be turned out than with the old arrangement.

It is surprising to see, as we look around, how little consideration is given to the proper arrangement of some motor-driven machines. Looking over a large shop recently, the writer saw drives of nearly all descriptions. In some cases the motors were connected directly to the machines by gears, some by silent chains, and others were connected by placing the motor upon the floor and retaining the old countershaft with the necessary belts. Some of the machines were group-driven, and in many cases the controllers were conveniently located. Altogether, the general scheme seems to have partaken of the hit-or-miss style.

Another shop visited presented quite a contrast; here the idea seems to prevail that leather should be used for shoe-soles or hydraulic cylinder packing, but not for driving machinery. In one corner of the shop the machines are at present driven as a group, but the large majority of machines are driven by individual motors. Each application was considered by itself, and only what seemed best was adopted. The controllers are conveniently located, so that the operator can easily adjust the machine's speed while it is in motion. Gears and chains are covered, not only to keep out the dust, but to prevent interference with a misplaced finger. In the main, the scheme in the latter shop seems to be very convenient.

As these two shops are close enough together to be neighborly, each might have derived considerable benefit from a mutual interchange of ideas and opinions. But the business of motor application is so new that the best cannot as yet be consistently expected.

M. E.

HEAVY DRIVING-WHEEL LOADS.

To the Editor:

On page 153 of the current number of the *AMERICAN ENGINEER* there appears an illustrated description of the 4-4-2 type express locomotives recently built for the Vandalia Line by the American Locomotive Company at their Schenectady Works.

In the course of this article the following statements occur: "These are heavy engines, weighing 179,444 lbs., with 109,500 lbs. on driving wheels. This is the most remarkable feature of the design, as a weight of 27,375 lbs. per wheel is the greatest driving-wheel load in our record of locomotives. This even exceeds the practice of the Pennsylvania Railroad in the Class E2 and E2a engines, which have 109,033 and 109,000 lbs. on drivers, respectively."

In regard to the latter statement, I beg to direct attention to the fact that, according to the official classification book issued by the motive-power department of the Pennsylvania Railroad, May 1, 1902, the adhesive weight, in working order, of the Class E3, 4-4-2 type locomotives, is as follows:

Weight on first pair of drivers.....	55,000 lbs.
Weight on second pair of drivers.....	56,600 lbs.
Total	111,600 lbs.

This represents an average load of 27,900 lbs. per wheel, and testifies eloquently to the solidity of the magnificent permanent way and bridges of the Pennsylvania Railroad. In these locomotives, 55.5 sq. ft. of grate area and 2,640 sq. ft. of total heating surface are apparently found quite sufficient to utilize 111,600 lbs. of adhesive weight, through the medium of 22 x 26-in. cylinders, 80-in. driving wheels, and 205 lbs. steam pressure. This indicates what can be accomplished by a properly designed boiler, in which good circulation and a moderate amount of heating surface are substituted for the far too common practice of providing an enormous heating area, which is frequently rendered of relatively low efficiency by poor circulation, induced by contracted firebox water spaces and overcrowding of the flues.

EDWARD L. COSTER,
Assoc. Am. Soc. M. E.

25 Broad St., New York, April 11, 1904.

EXTENDED SMOKE BOXES FOR LOCOMOTIVES.

To the Editor:

After reading your very interesting letter in the April number of the *AMERICAN ENGINEER* it occurred to me more forcibly than ever, *Why are the American railways using the extension front end?* When it first came into use it was intended for a spark-arrester, and was so constructed that it did hold sparks to a certain extent; but after a while, when the novelty had worn off, the engineers would not blow them out except when actually obliged to in order to get steam. Since that time a great many master mechanics have succeeded in putting up front ends which will clear themselves. Now, if that is what we have come to, what is the need of all this extra expense in maintaining so much paraphernalia in a front end, if the people on the other side can get a better steaming

locomotive with a smokebox like the one shown on the Caledonian locomotive? I do not see why we should use such a cumbersome thing on the fronts of our boilers. I know from experience that our locomotives steamed better with the diamond stack than they ever have after fitting them with the extension front end. The inside arrangement was the same as the New York Central is using today. Of course, we cannot say at this time how the present large boilers would work with a short smokebox, but I do not see how it could be any different with them than with the smaller ones. After noting what you say about the performance of the Caledonian's locomotive to the ton of coal, it looks to me as if we were a long way in the rear of our cousins on firebox and front-end arrangements. Instead of going ahead for the past fifteen years, it seems to me we have gone back in the matter.

GEORGE A. FERGUSON.

N. Y. C. & H. R. R. R., Depew, N. Y.

AN IMPORTANT NEW TERMINAL-YARD, LIGHTING AND POWER PLANT.

WEEHAWKEN, N. J.

WEST SHORE RAILROAD.

IV.

(Continued from page 128.)

THE GENERATORS.

As indicated in the plan drawing of the engine room in the inset supplement accompanying the second article of this series (March, 1904), the generator equipment of the Weehawken

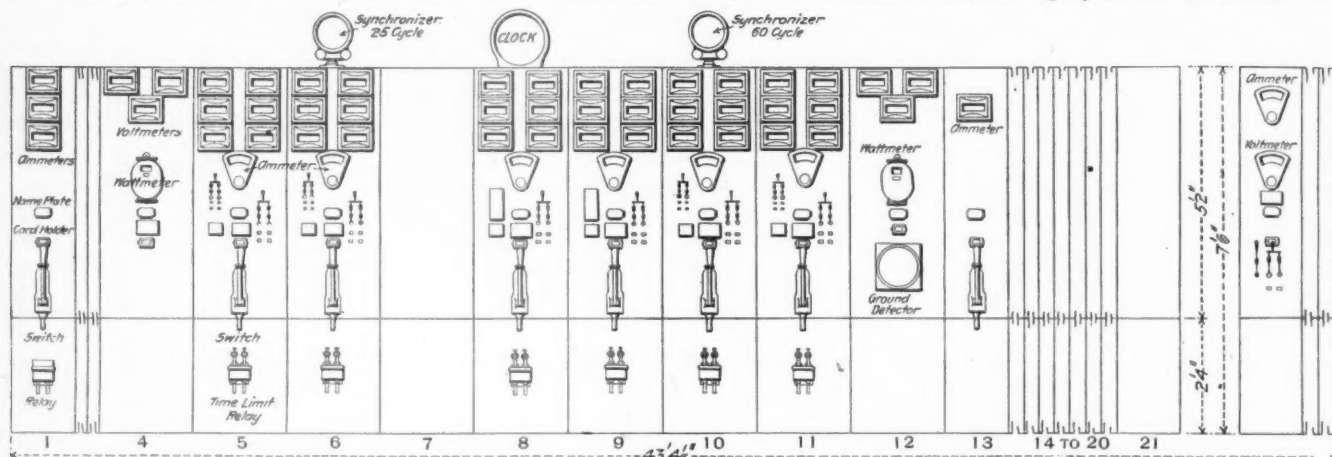


DIAGRAM OF THE SWITCHBOARD, SHOWING ARRANGEMENT OF GENERATOR AND FEEDER PANELS, WITH INSTRUMENTS.
TERMINAL-YARD LIGHTING AND POWER PLANT.—WEST SHORE RAILROAD.

power plant consists of four slow-speed alternating-current generators, each direct connected to a Westinghouse horizontal Corliss engine. All four machines are of the engine type with revolving fields and are wound to deliver three-phase alternating current, but the two smaller machines are intended for a different class of service than the larger ones and thus differ somewhat in service details.

The two alternators driven by the 1,200-h.p. engines are each of 750-kw. capacity and deliver the 3-phase current at a frequency of 25 cycles and at a voltage of 600 volts with the normal engine speed of 94 rev. per min. Those direct-connected to the 650-h.p. engines are each 400-kw. capacity machines, and are designed to deliver 3-phase alternating current at a frequency of 60 cycles and at a voltage of 2,300 volts with the normal engine speed of 120 rev. per min.

Both sets of machines have revolving field coils and stationary armature windings, with all high-voltage connections carefully covered. The construction is of the latest and most modern type, and is planned to prevent disagreeable humming from structural defects. The insulation of each machine is carefully looked to, it being specified that the insulation resistance between windings and that between windings and core shall be a megohm; the windings are also subjected to the usual high-voltage tests of more than double the normal running voltage. The machines are all wound for close regulation

efficiency of these machines is guaranteed to be 95 per cent. at full load.

The two 400-kw. generators were supplied, also with a 50-kw. 250-volt, direct-current exciter, by the General Electric Company, Schenectady, N. Y. The rating of these alternators is that they shall deliver their normal full load for twelve hours continuously without an increase of temperature of any part more than 40 degrees, C., above that of the surrounding air; they will also carry a 25 per cent. overload for two hours without temperature rise of more than 55 degrees, C., and a 50 per cent. overload continuously for five minutes without injury to the insulation. The efficiency guaranteed for these machines is 93 per cent. at full load.

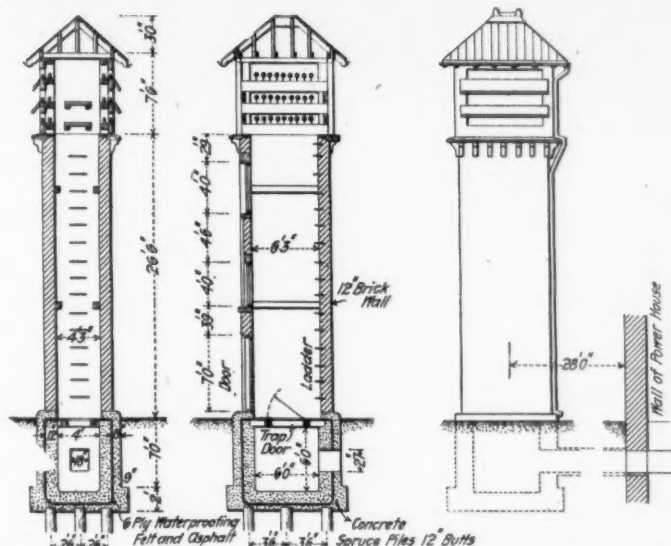
Both exciter generators are multipolar direct-current machines and are direct-connected to 90-h.p. Westinghouse vertical cross-compound engines. They are each of 50-kw. capacity and have ratings similar to that of the alternators. They are wound for close regulation, with means for easily adjusting the percentage of compounding either 5 per cent. above or below normal, and have guaranteed efficiencies at full load of 90 per cent. The exciter units are located beneath the switchboard gallery, as indicated in drawings in the preceding articles.

It may be a matter of surprise to many that alternating current is to be generated in two different frequencies, namely

in 25 and 60 cycles. But this is to be done on account of the peculiar operating conditions, which are to be met in this plant. The two larger machines are intended to carry the motor load of the distribution system and the two smaller machines will take care of the lighting load. It was found that by using 25 cycles (instead of 60 cycles) a large amount of money could be saved by the elimination of reduction gearing

a 50-per cent. overload for five minutes continuously without injury to the insulation. The efficiency of the set is 85 per cent. at full load. The fields of both machines are wound for the standard exciting current of 250 volts. This machine was also furnished by the General Electric Company.

The usefulness of this motor-generator set will be readily apparent. In the day-time, when the lighting load is very low and the power circuits are in operation, what small amount of lighting current will be required can be thus transformed from the 25-cycle power circuits by its use, and thus the 400-kw. generators may be allowed to stand idle. Conversely in the night, when the lighting circuits are in use, any small amount of current that may be required on the power circuits for night work in the repair shops, or otherwise, may be transformed from the 60-cycle lighting current, which will relieve the 750-kw. generators from operation at very light loads at night time. In this way the motor-generator set serves as a combined voltage and frequency transformer and is used as an interconnecting link between the two electrical distribution systems. Its use may be readily seen to be very important in thus saving either set of generators from being compelled to be operated at extremely light loads, at any time. Another important advantage of the use of the motor-generator set, is that during light loads upon one system, the power factor on the other system can be greatly increased by overexciting the motor field.

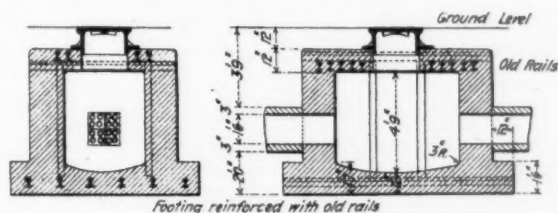


DETAILS OF THE SPECIAL CABLE TOWER, OUTSIDE THE ENGINE ROOM, FOR LEADING OUT THE OVERHEAD AND UNDERGROUND DISTRIBUTION CIRCUITS.

at the motors, inasmuch as with 25 cycles the motor-speeds are correspondingly lower; the saving in gearing for the grain-elevator motors alone is estimated to amount to nearly \$10,000. The higher frequency (60 cycles) was used for the lighting circuits inasmuch as arc lights operate much more satisfactorily at this frequency.

The question of voltage was also an important consideration. The voltage of the power circuits was made relatively high (600 volts) in order to save transmission losses; yet this voltage is not too high for interior use with safety. The economy of this voltage, over 110 or 220 volts, is considerable in the operation of the large motors used in the grain elevators as the transmission distance is fully 1,000 ft. The distribution circuits for the lighting system are operated at 2,300 volts, because of the extended area of the lighting circuits.

In addition to the above-mentioned equipment of the engine



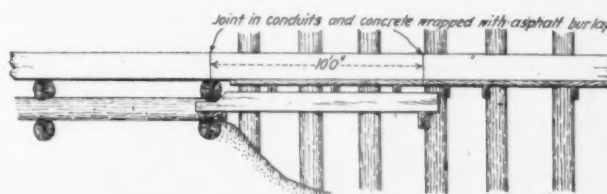
DETAILS OF TYPICAL MANHOLE CONSTRUCTION OF THE UNDERGROUND CONDUIT SYSTEM, AND OF FLEXIBLE CONSTRUCTION AT DOCK BULKHEADS TO PERMIT UNEQUAL SETTLING OF GROUND LEVEL.

room there is also a motor-generator set installed for an interesting class of work. This motor-generator consists of two revolving-field engine-type machines, mounted on one shaft and bedplate. This machine is designed to deliver from one side a 3-phase alternating current at a frequency of 60-cycles and potential of 2,300 volts, when supplied on the other side with a 25-cycle 3-phase alternating current of 600 volts; it will also similarly deliver a 25-cycle, 3-phase alternating current at 600 volts when supplied with a 60-cycle 3-phase alternating current of 2,300 volts in the opposite order. This outfit has a capacity of 100 kw. at a speed of 300 rev. per min. Both machines have stationary armature windings and are carefully constructed and insulated. The rating of these machines is that they shall deliver a 25-per cent. overload continuously for one hour without temperature rise of any part more than 55 degrees above that of the surrounding air, and to carry

SWITCHBOARD.

The switchboard is located at the southeast corner of the engine-room upon a gallery of structural steel construction with a concrete floor, 11 ft. 4 ins. above the main floor. It is a large board, consisting of 24 panels and is constructed of 2-in. blue Vermont marble of the best quality. Each panel is of the uniform height of 7½ ft., including a sub base; panels numbered 4 to 12 inclusive, are 24 ins. wide and the remainder are 16 ins. wide. The board is mounted upon a strong framework of angle iron construction with a polished oak base.

The front elevation drawing of the switchboard indicates the arrangement of the panels. The first three panels are feeder panels, each of 500-kw. capacity, for the 25-cycle, 600-volt 3-phase current. The fourth panel is a 1,500-kw. total output panel for these feeder panels, containing voltmeters, a Lincoln synchronizer and a total recording wattmeter. Panels Nos. 5 and 6 are the generator panels for the 750-kw. 25-cycle 3-phase generators, and panel No. 7 is a blank panel to be held in reserve for a future 750-kw. generator.



Panel No. 8 controls the 600-volt 25-cycle side of the motor-generator, and panel No. 9, the 2,300-volt, 60-cycle side of the same, the capacity of either panel being 100 kw. Panels No. 10 and 11 are the generator panels for the 60-cycle, 2,300-volt, 3-phase generators, and Panel No. 12 is a 800-kw. total output panel for the 60-cycle, 2,300 volt current, containing voltmeters, a Lincoln synchronizer and a total recording wattmeter, like the other total output panel. Panels Nos. 13, 14, 15 and 16 are 200-kw. feeder panels controlling the 60-cycle, 2,300-volt 3-phase power feeders and panels Nos. 17, 18, 19 and 20 are 100-kw. feeder panels controlling the 60-cycle, 2,300-volt single-phase lighting circuits. Panel No. 21 is blank, being held in reserve for a future feeder circuit.

Between panel 21 and the three panels shown at the extreme right is a space of 5½ ft., which is left vacant for the arc light circuit controlling apparatus, the type of which will be

determined later. The remaining three panels shown at the right hand end of the board are 50-kw., 250-volt, direct-current panels, each controlling one of the exciter generators for the field excitation circuits of the various generators and motor-generators; panel No. 24 is held in reserve for a future exciter.

The equipment of the switchboard embodies the latest improvements in alternating current work. The alternating current generators, as well as all power feeders, are connected by oil switches at the controlling panels, and their field circuits are controlled by field discharge switches, which will automatically short-circuit the field coils so as to discharge the heavy and dangerous momentary rise of potential that results when the field excitation circuit is opened. The generator circuit breakers are of the time delay type, having overload time interval devices to prevent them from opening on the momentary "cross-currents" due to "hunting" of the generators. All the rheostats are located just beneath the switchboard gallery floor and are operated by hand wheels, conveniently located upon floor stands in front of the switchboard as shown; this location makes an important provision against fire at the rear of the switchboard—the usual location. The wiring is fire-proof throughout by the use of fireproof-braid covered wire.

DISTRIBUTION SYSTEM.

All the distribution circuits leave the switchboard by way of the fireproof transformer vault underneath in the basement, to which they are carried through tile conduits. These lead vertically downward from behind the switchboard, so that they are not exposed to injury on the engine floor, behind the exciter units. This transformer vault is located directly under the switchboard gallery, as shown in the basement plan, presented in the preceding issue; it is a room of fireproof construction and contains all the station transformers, tub transformers and other similar electrical apparatus; in case of fire the same will thus be localized at this point. It is important to note here that the lightning arresters are all located outside the power house.

From this vault the feeder circuits leave the building through

an underground connection to a separate cable tower, which has been erected just outside the engine-room wall. The general system of lighting and power feeders are carried away from here by overhead lines, although the feeders to the elevators, across the yard, are carried in underground conduits, owing to the congestion of tracks in that direction. The overhead lines lead to the points of distribution at both ends of the yard, the usual step-down transformers being located at centers of consumption. In all cases the power feeders and lighting feeders are kept entirely separate, as the power circuits are operated with all three phases and the lighting circuits single phase. All the power and lighting circuits carried on the pole lines use the 60-cycle, 2,300 volt current, the 25-cycle, 600-volt current being used exclusively for the operation of motors at the grain elevators.

The power feeders for the grain elevator, which also supply the lighting circuits there, are carried in a 16-duct underground conduit, leading from the transformer vault, directly across the yard to the elevators. These conduits are constructed of four 4-duct tiles, laid in concrete, as shown in the accompanying engraving. An important feature of this conduit construction is that it is arranged, where necessary, for flexure and variation of level. Near the dock bulkheads an interesting form of construction is made use of, as shown in the engraving; in this case the joints are loosely wrapped and rest upon logs to freely permit change of level without injury—this is particularly necessary at this point, owing to probable change of the ground level. The other interesting details of this construction are made clear in the engravings.

The entire Weehawken improvement is being developed under the general directions of Mr. W. J. Wilgus, Fifth Vice-President, and Mr. H. Fernstrom, Chief Engineer of the New York Central & Hudson River Railroad Company. The architectural features of the Power Station building were designed by Mr. C. W. Smith, and the steel structure by Mr. G. A. Berry, both reporting to Mr. Olaf Hoff, Engineer of Structures. Mr. C. J. Parker was in charge of the construction of the building and foundations. The electrical and mechanical portions of the equipment were designed and erected by Mr. Edwin B. Katte, Electrical Engineer of the railroad company.

MOTOR-DRIVEN MACHINE TOOLS.

APPLICATIONS TO SPECIAL MACHINERY.

The importance of the electrical method of driving machine tools by individual motors has often been discussed in these columns, in the various phases of its applications to different branches of shop work, but the magnitude of the subject and the very extensive scope of operations in testing its usefulness prohibit a comprehensive treatment of the question in any single article. In this article it is desired to call attention to the scope of the work that has been accomplished, as in no other way can it be shown how general the use of the electric motor is becoming in our machine shops.

While it is admitted that the introduction of motor-driving has not come unattended by a large number of troubles and that many difficulties have had to be overcome, still a glance at the various illustrations of motor-driving applications presented herewith is sufficient to indicate what a multitude of difficulties met in belt driving from line shafting have been avoided by the use of these motor drives. It is true that the difficulties met in the driving of special machinery have been instrumental, to a large extent, in bringing about the introduction of individual motor driving, as a result of which the many advantages were revealed and became understood. The various illustrations in this article give an idea of some of the possibilities.

Fig. 1 presents a view of a large machine shop, in which individual motor-driving is used exclusively for the machine tools; this is a remarkable example of the results that are ob-

tained by the exclusive use of this system. Not a single line shaft or countershaft is to be seen in this shop, the only belts used being those upon individual machines. The light and airy effect of the absence of overhead shafting and belts, as well as also the cleanliness possible, is well shown by this view, which is of one section of the machine shop of the Bullock Electric Manufacturing Company, Cincinnati, Ohio.

This is a condition, however, that may be found at a large number of different shops in this country at the present time. It is interesting to note that not only the electrical manufacturing shops, but also some of the largest industrial shops have adopted this system to the exclusion of belt driving, for reason of the many advantages. Among the latter may be mentioned, as one of the most important, the works of the Wellman-Seaver-Morgan Company, Cleveland, Ohio. In this shop also not a belt is to be seen, even the smallest tools, such as power hack saws and the like, being individually driven by motors. Many other shops using this system exclusively have been mentioned in these columns.

The effect of this rapidly increasing use of the motor-drive has been to make severe demands upon the machine tool builders to adapt their tools to the requirements of the new drive. In this interesting work the Betts Machine Company, Wilmington, Del., have been pioneers. They have anticipated the trend of progress in this direction and have done very important work in the development of practical motor-drive applications. Fig. 2 illustrates a neat and serviceable drive which they have applied to one of their large crank-driven slotters. The motor has been conveniently mounted upon the side of the frame at the rear and drives direct through gearing, there

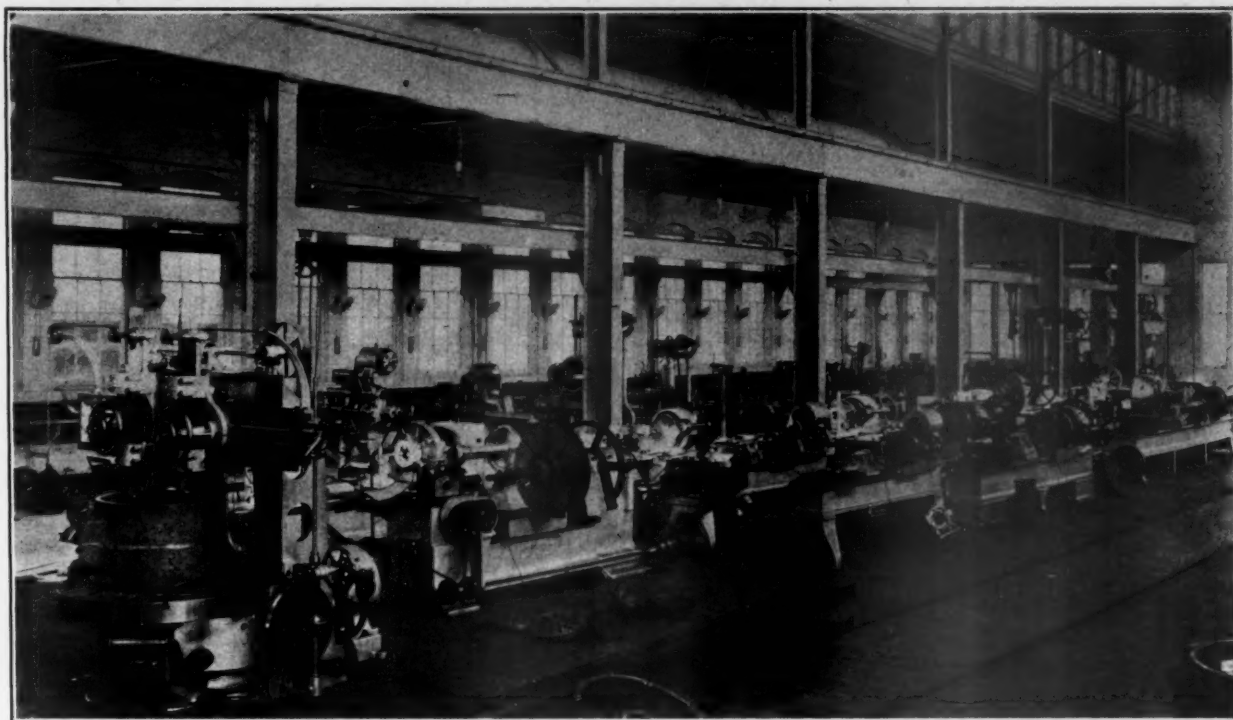


FIG. 1.—A MODEL MOTOR-DRIVEN MACHINE SHOP.—WORKS OF THE BULLOCK ELECTRIC MANUFACTURING COMPANY.

being three runs of gearing for changes of speed. In this way the motor requires practically no additional room and is out of the way of the operator. The motor used is a General Electric Company direct-current motor, operating at variable speeds by field control.

In Fig. 5 is illustrated another Betts tool arranged for motor-driving. This is the Betts standard horizontal boring machine, and in arranging for the motor-drive the cone pulleys were retained. An interesting method of overcoming the difficulty of tightening the belt of such short length is to be seen on this tool; the motor is mounted upon a rocking bracket over the headstock, so that the motor and all may be tipped back to tighten the belt. This motor is also a General Electric direct-current motor, similarly arranged for variable speeds, and drives the upper cone pulley direct through a gearing reduction.

Fig. 3 is an illustration of an application of motor-driving to a large horizontal boring, drilling and milling machine, built by Beaman & Smith, Providence, R. I. On account of the size of this tool the problem of applying the drive was much simpler, but the neatness and compactness resulting from this arrangement of the drive are worthy of particular notice. There is here no possible interference with crane service in handling heavy pieces of work into the tool, and thus the tool may be operated in any part of a shop regardless of surroundings. The motor used here is a Bullock direct-current motor, operating at variable speeds by the multiple-voltage system.

Figs. 4 and 6 illustrate two interesting Crocker-Wheeler drives applied to operate machines at variable speeds by the multiple-voltage system. The former is a large Bement, Miles & Company horizontal planer-type milling machine, with special gear mechanism for adjusting the feeds. The motor is mounted upon the side of the frame at the rear, in place of the usual belt-drive pulleys, and drives direct from there through gearing. This motor is a 15-h.p. direct-current motor, and the controller for operating it in connection with the multiple-voltage system is shown at the front, convenient to the operator.

The Reliance Machine & Tool Company of Cleveland, Ohio, is another of the progressive tool builders that have shown appreciation of the increasing popularity of the motor drive. In Fig. 6 is shown their new 3-inch bolt cutter arranged for driving by a Crocker-Wheeler motor, mounted on a bracket at the back of the machine, replacing the usual four-

step cone pulley. This view is taken from the motor side of the machine to show the five trains of reducing gears through which the power is delivered to the spindle at a point midway between its bearings; this is an important advantage in effecting a smooth and even drive. Besides saving in floor length this also places the gears out of the way of injury even when not enclosed. The motor-controller is mounted horizontally on the end of the frame under the head, with the handle extending towards the operator, conveniently within his reach, while standing in a position to operate all other movements of the machine.

Additional examples of motor driving will be presented in a subsequent article.

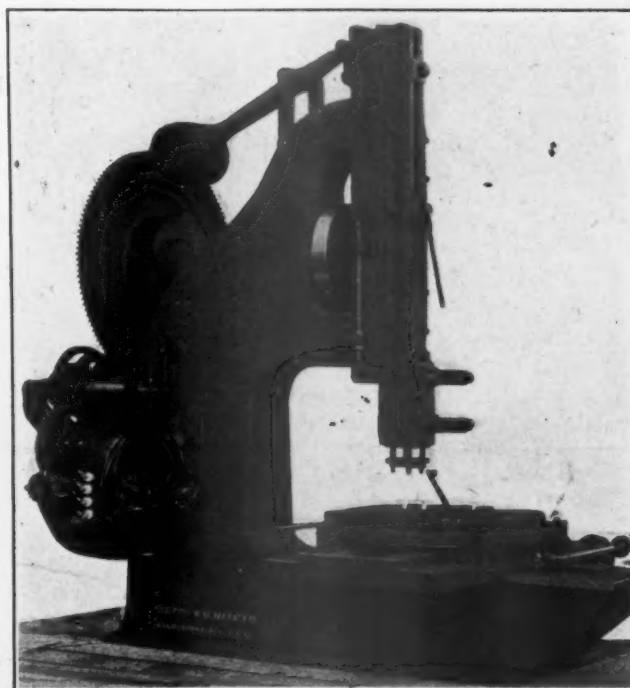


FIG. 2.—GEARED VARIABLE-SPEED MOTOR-DRIVE UPON A LARGE SLOTTER.—BETTS MACHINE COMPANY.

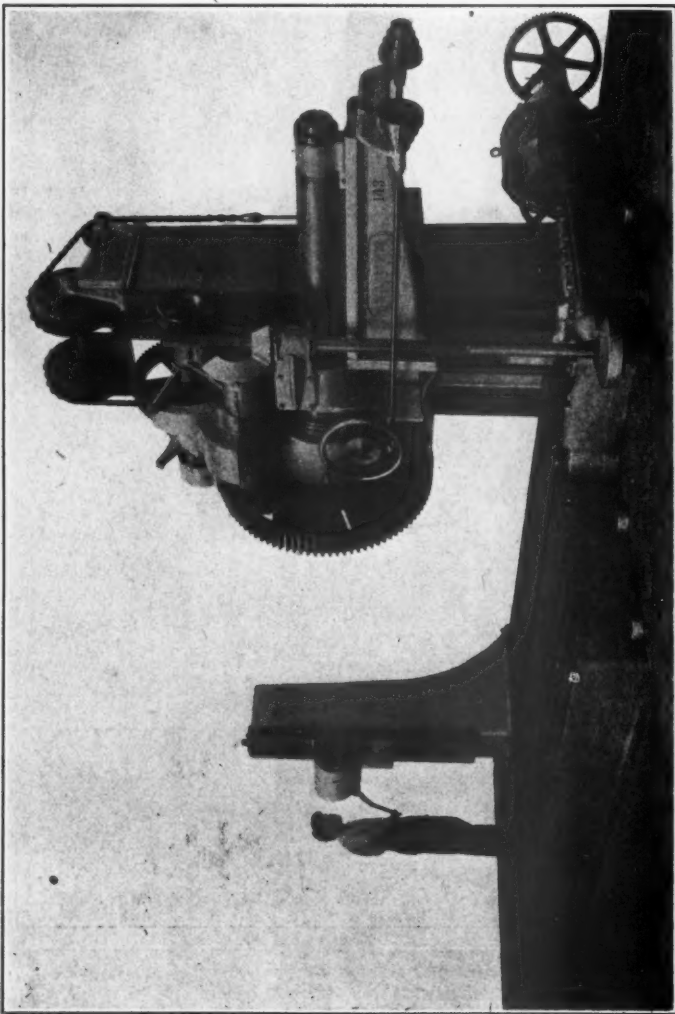


FIG. 3.—DIRECT DRIVE FOR A LARGE HORIZONTAL BORING, MILLING AND DRILLING MACHINE.—BEAMAN & SMITH.

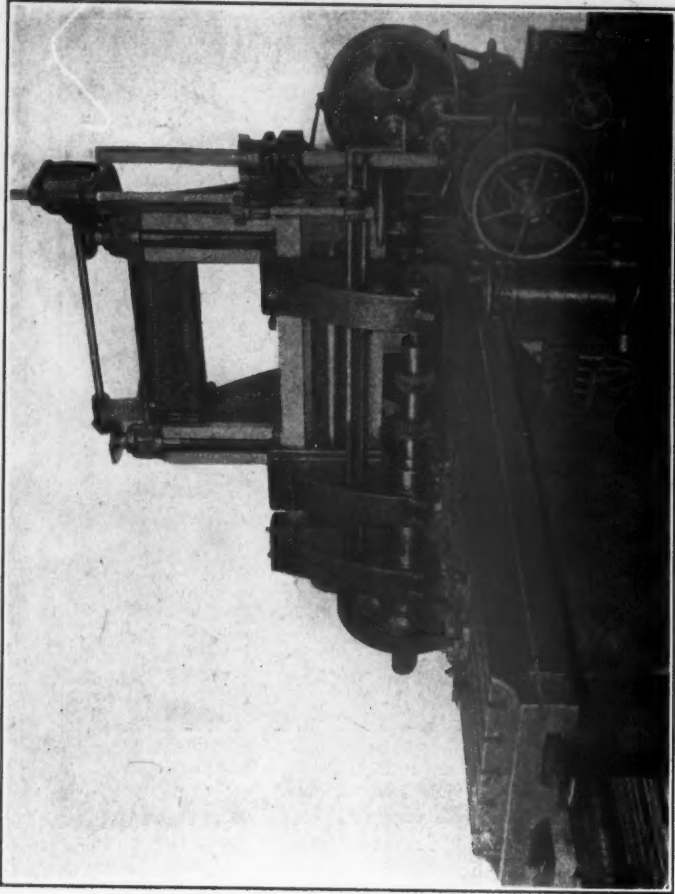


FIG. 4.—CROCKER-WHEELER MULTIPLE-VOLTAGE MOTOR DRIVE UPON A LARGE HORIZONTAL MILLING MACHINE.—HEMENT, MILES & CO.

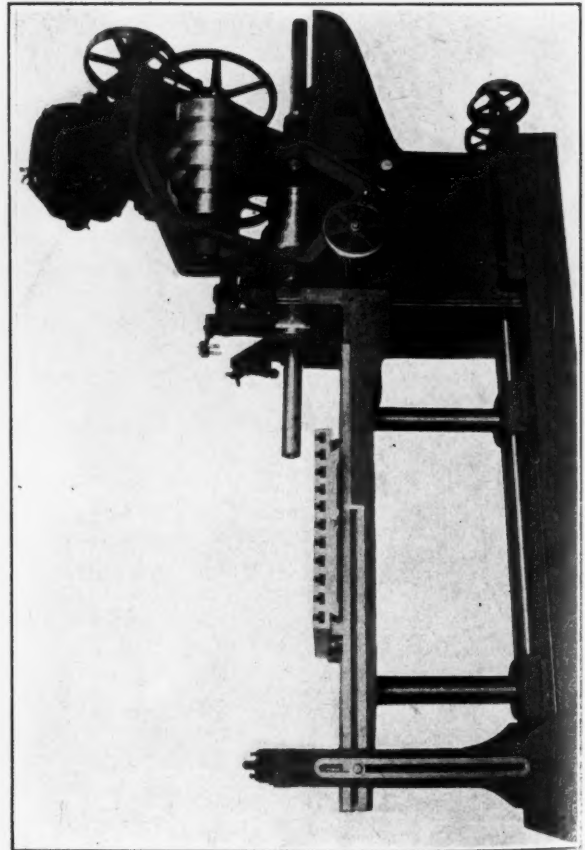


FIG. 5.—BELTED VARIABLE-SPEED MOTOR DRIVE UPON A HORIZONTAL BORING MACHINE.—BETTS MACHINE COMPANY.

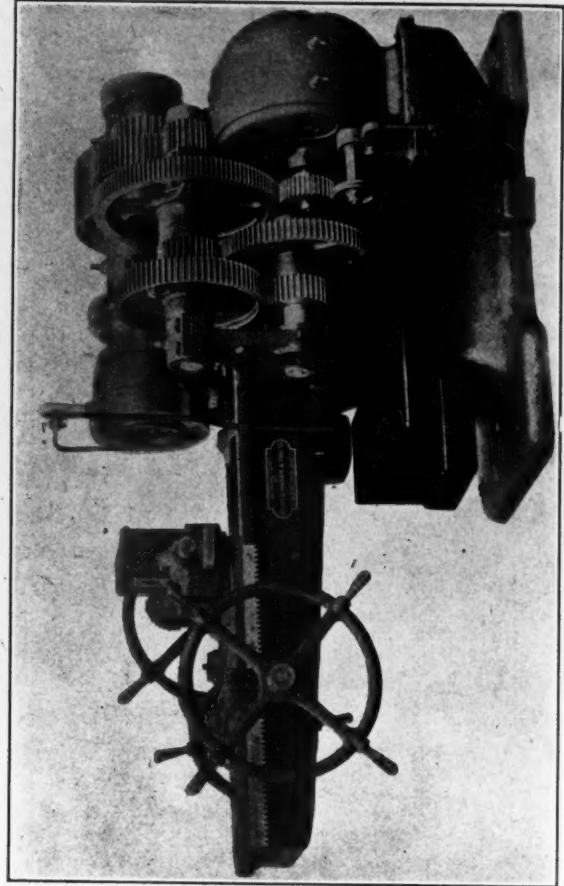


FIG. 6.—CROCKER-WHEELER MULTIPLE-VOLTAGE DRIVE UPON A 3-INCH BOLT CUTTER.—RELIANCE MACHINE AND TOOL COMPANY.

THE APPLICATION OF INDIVIDUAL MOTOR-DRIVES TO OLD MACHINE TOOLS.

McKEES ROCKS SHOPS.—PITTSBURGH & LAKE ERIE RAILROAD.

BY R. V. WRIGHT, MECHANICAL ENGINEER.

X.

THE BORING MILLS.

Some interesting changes were necessary in adapting the individual motor driving to the old boring mills which it had been decided to thus equip for the new McKees Rocks shops. The more important work in this line was in connection with the 48-in. Pond car-wheel borer and the 72-in. Pond boring mill, which had been used at the old shops, and this article will describe the work necessary in changing them for electrical driving.

THE CAR WHEEL BORER.

Fig. 48 illustrates the old 48-in. Pond car wheel borer, as equipped with an individual motor for variable speed driving. As this tool is used exclusively for the facing of hubs of and the boring of car wheels, the range of table speeds required is not very great, and it was seen that the motor could easily take care of it without any additional runs of gearing. Accordingly the speed cone which was used with the belt drive was simply replaced by the large Morse silent-chain sprocket, B, which receives the drive direct from the motor, as shown. The motor was arranged to be supported by a substantial cast iron bracket which is bolted to the frame of the tool in a convenient position for the drive. On account of the projecting location of the rear end of the hub facing spindle and of the feed belt, it was necessary to make the motor bracket of a rather irregular design, as shown in the drawing, although a very solid and substantial design was effected.

The motor is a Crocker-Wheeler type 10 I-L.S.-C.M. multiple-voltage motor, and is operated at variable speeds by a type

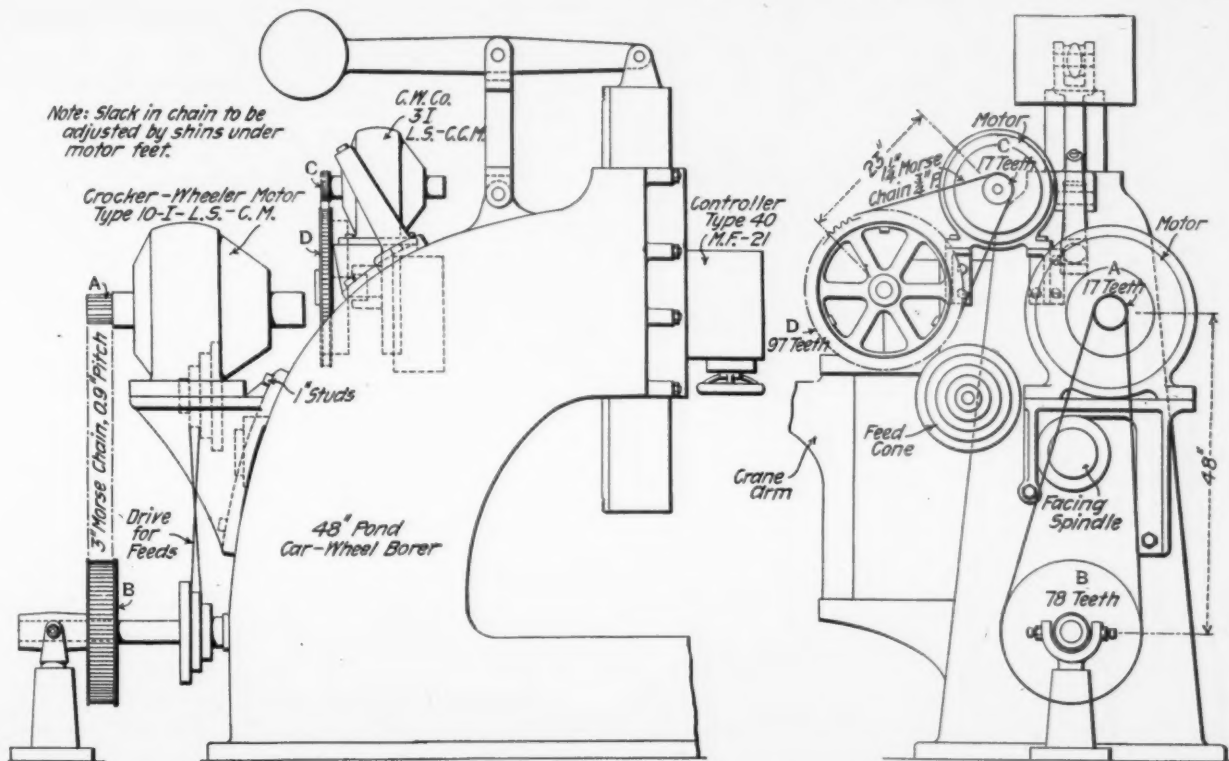


FIG. 48.—DETAILS OF THE APPLICATION OF INDIVIDUAL DRIVING TO THE 48-INCH POND CAR-WHEEL BORING MACHINE, SHOWING ALSO ARRANGEMENT OF SEPARATE MOTOR FOR OPERATING THE WHEEL HOISTING CRANE.

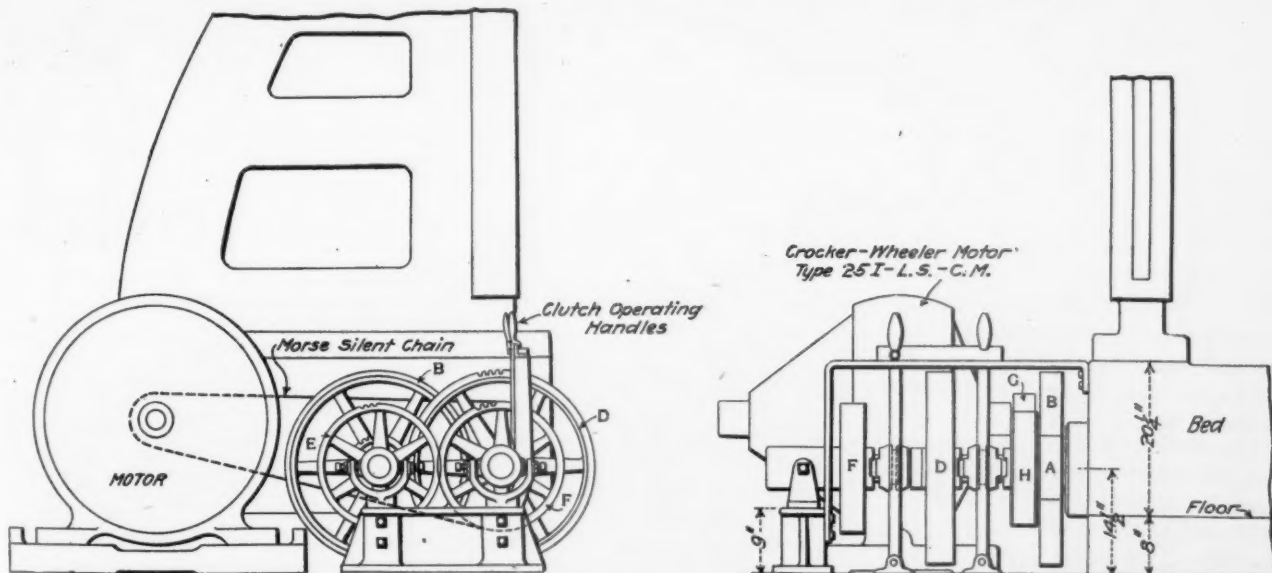


FIG. 49.—THE MOTOR DRIVING ARRANGEMENT FOR THE 72-INCH POND BORING MILL, SHOWING USE OF THREE GEAR RUNS AND INTERLOCKING LEVERS FOR OPERATING THEM.

40-M.F.-21 controller. This gives the tables a range of speeds of from 2.8 to 35 rev. per min. The controller is mounted on the front side of the boring-spindle frame, as shown, which makes it very convenient for the operator.

The small crane for placing wheels and work upon the table, which forms a part of this tool, was formerly operated by a pulley which was driven from the countershaft; this pulley ran continuously and the crane was operated by the throwing in or out of a clutch. Part of this clutch was cast in as a part of the pulley, so that in order to preserve this combination

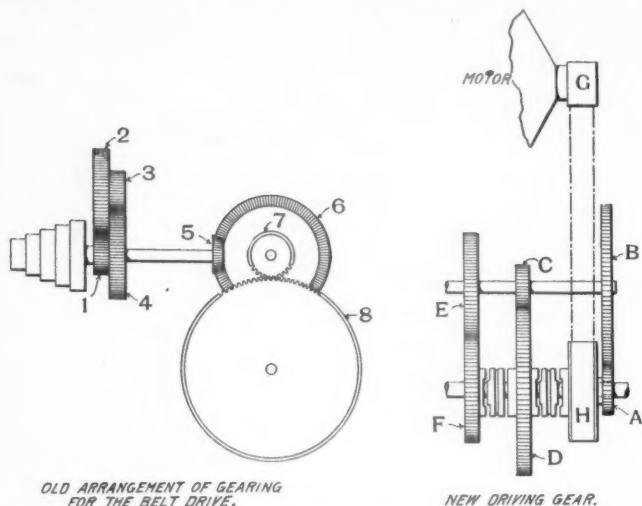


FIG. 50.—DIAGRAMS OF THE OLD AND NEW ARRANGEMENTS OF GEARING FOR THE DRIVE OF THE 72-INCH MILL, INDICATING THE CHANGES NECESSARY TO BE MADE.

and avoid making a new clutch mechanism, the large Morse chain sprocket, D, was made so that it could be slipped on to the pulley and bolted to it, as shown. The motor which is used to operate this crane mechanism is a Crocker-Wheeler type 3 I-L.S.-C.C.M. motor, and is supported by two cast-iron brackets.

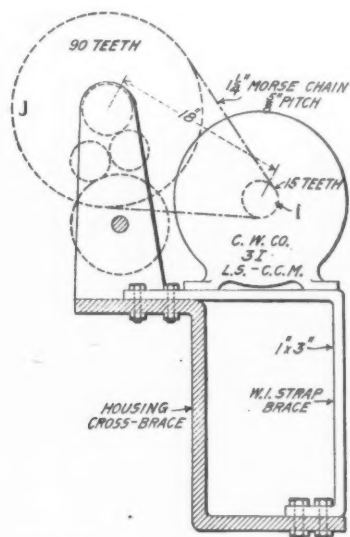


FIG. 51.—ARRANGEMENT OF THE INDIVIDUAL MOTOR DRIVE FOR OPERATING THE CROSS RAIL, RAISING AND LOWERING MECHANISM.

THE BORING MILL.

Figs. 49 and 50 illustrate the application of the individual variable-speed motor drive to the old 72-in. Pond boring mill. This application involved an interesting change in the gearing runs.

Fig. 50 shows the arrangement of the belt cone and back gearing which were formerly used with the belt drive. Gears 2 and 3, which were cast in one piece, ran loose on a short stud shaft and, as back gears, were thrown in and out in practically the same manner used on the ordinary back-geared engine lathe.

In applying the motor the entire arrangement of belt cone and gears 1, 2, 3, and 4, were removed and the stud shaft was replaced by a longer shaft having an outboard bearing. A com-

plete new set of gearing and clutches for changing runs were added, as shown in the other half of the same diagram, Fig. 50, and these are arranged to be driven from the motor by means of a Morse silent chain, as shown. The arrangement of the runs of gearing, clutches and clutch interlocking device are practically the same as used upon the lathe described in the second article of this series—pages 166 and 167, May, 1903.

The motor used for this drive is a Crocker-Wheeler, type 25 I-L.S.-C.M. motor and is operated through a type 80-M.F.-21 controller. The controller is mounted upon a floor stand close to the frame of the tool, at the right side of the table, so as to be in a convenient position for the operator. The table has a total range of speeds of from 0.24 to 23.5 rev. per min., and the motor has a nominal capacity in horse-power of 15 from .86 to 23.5 rev. per min. of the table.

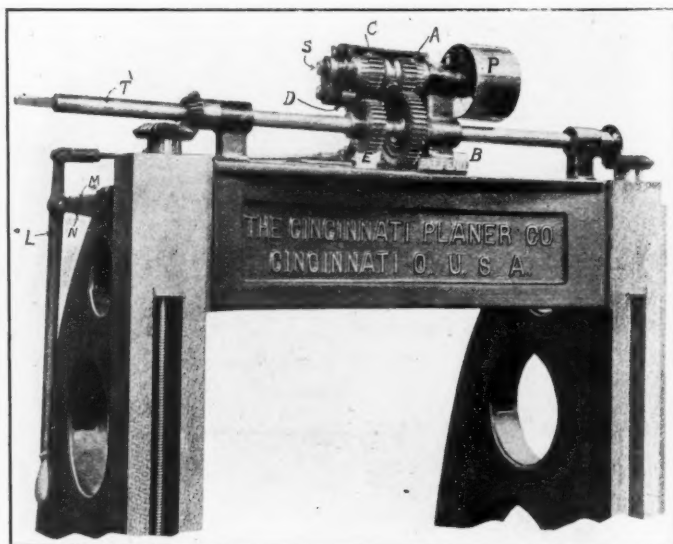
The crossrail is raised and lowered by means of a separate motor (Crocker-Wheeler type 3 I-L.S.-C.C.M.), which is mounted on top of the cross brace of the housing. This arrangement is shown in a separate drawing, Fig. 51. The motor rests upon a bracket of wrought iron straps and drives, by means of a Morse silent chain, the cross-rail gearing which was formerly operated by belt from the countershaft.

THE LANGEN POWER CROSS-RAIL ELEVATING MECHANISM FOR PLANERS.

DESIGNED BY GEORGE LANGEN.

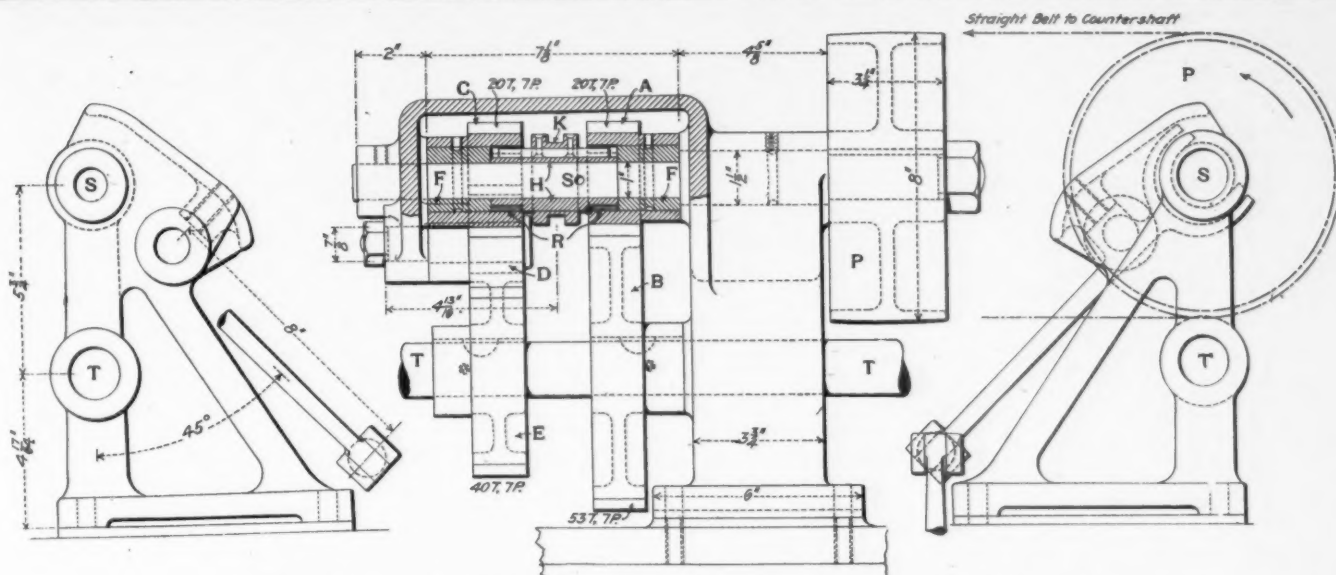
Provision for elevating or lowering a planer cross-rail by power is one of the most important features of the equipment of a planer, and is one the importance of which as a time saver has not been appreciated. The accompanying engraving illustrates a new power elevating mechanism of striking originality for this work, which will replace the usual method of operating the elevating screws by throwing tumbler gears in mesh with a jerk. The advantage of the scheme of this device is that it can be thrown in gear while the tool is running, absolutely without shock.

The half-tone engraving shows the location and appearance



THE LANGEN IMPROVED ELEVATING DEVICE FOR THE CROSS RAILS OF METAL PLANERS.

of the mechanism, with cover removed, upon the arch of a planer housing; the details are shown in the accompanying drawing of the device. The mechanism receives its power from the countershaft upon pulley, P, which is keyed on and drives shaft, S. From the mechanism, power is delivered through gears, B or E, to the shaft, T, which operates the elevating screws. The interesting feature is the friction cone connection by which either the raising or lowering train of gearing is set into operation. The mode of operation may be understood from the detail drawing.



DETAILS OF THE LANGEN POWER ELEVATING MECHANISM FOR PLANER CROSS RAILS.
CINCINNATI PLANER COMPANY.

Each of the driving gears, A and C, has a perforated bush, F, driven into its center, which eliminates the counterbore necessary for the spit-clutch ring, R, and their perforations also carry the oil for the bearing. R is the split clutch ring in either gear and H is a steel sleeve secured to the pulley shaft. This sleeve presents a new method of holding friction rings in place endwise, without putting in additional washers or collars; it will be noticed that the ends are turned down, so that each end fits loosely into the split ring, the center being left larger in diameter, so that the wedge rings cannot pull out of the gear. This steel sleeve is splined its entire length and the collar, K, has a key secured to it, which slides in this spline, and is tapered on each end to fit the taper opening in the split wedge rings, and consequently does the expanding on whichever side it is forced over by the levers.

A and B are the raising gears; C, D and E are the lowering gears. It can readily be seen that the raising gear B is much larger in diameter than the gear used for lowering the rail. This gives a slow speed and plenty of power for raising the weight of the rail. D is an idler gear used to revolve gear E in opposite direction of gear B. The lowering gear, being smaller in diameter, gives one-third higher speed while letting down the rail, when there is practically no power required.

The half-tone shows this device as applied to a Cincinnati planer. It is so situated on the arch as to bring the large driving gear that raises the rail exactly in the center of the machine, so that if there should be any torsion to the elevating shaft, it will be distributed equally on each side. The bracket also provides for an additional bearing for the elevating shaft to take care of any spring or side thrust that may be caused by the gears.

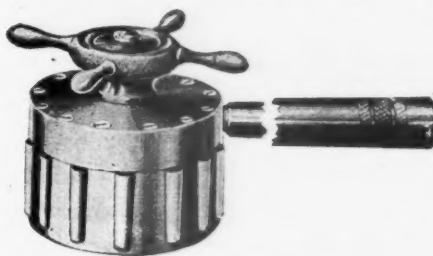
L is a long handle pivoted on bracket M, and reaches down on the side of the housing to within convenient reach for the operator. This long handle gives a long leverage for operating the taper counter-wedges, and so gives the operator full control of the movement of the rail, making it possible to raise or lower the rail to within a scratch line on the housing. N shows the handle ends of the locking screw, which is used to hold this handle in a fixed position while not in use. On the larger machines this locking device is brought down near the handle, so that it can be reached from the floor.

This new power elevating device is the invention of Mr. George Langen, superintendent of the Cincinnati Planer Company, Cincinnati, Ohio, which company will hereafter place the same on their entire line of planers.

Mr. G. R. Joughins has resigned as mechanical superintendent of the west lines of the Santa Fe to accept the position of superintendent of motive power of the Intercolonial Railway of Canada, with headquarters at Moncton, N. B.

TRIPLE VALVE BUSHING ROLLER.

The device illustrated by the accompanying engraving is designed to render the repairs of triple valve bushings easy and rapid, and to make it possible to do this work with relatively unskilled labor. It was developed at the San Bernardino shops of the Atchison, Topeka & Santa Fe Railway. The device rolls the bushings by means of a series of small conical rollers, which are held in a cylindrical casing. This casing provides a housing for the rollers, the exterior surfaces of which project through slots in the casing. The rollers are urged in an outward direction by the pressure of a cone, which is adjusted by a screw and thereby adjusts the position of the small rollers by being moved in and out by means of the hand wheel upon the top of the device. The taper of the cone and the rollers is such as to give a perfectly cylindrical surface to the bushing when the device is turned by means of the handle shown in the engraving. A triple valve with a worn bushing is secured in a socket vise. The roller device is inserted in the bushing. The rolls are pressed outward by means of the hand



TRIPLE VALVE BUSHING ROLLER.

wheel, and the irregularities due to wear are rolled out, leaving the bushing smooth and symmetrical. When the operation is completed the rollers are withdrawn into the casing and the device is removed from the bushing.

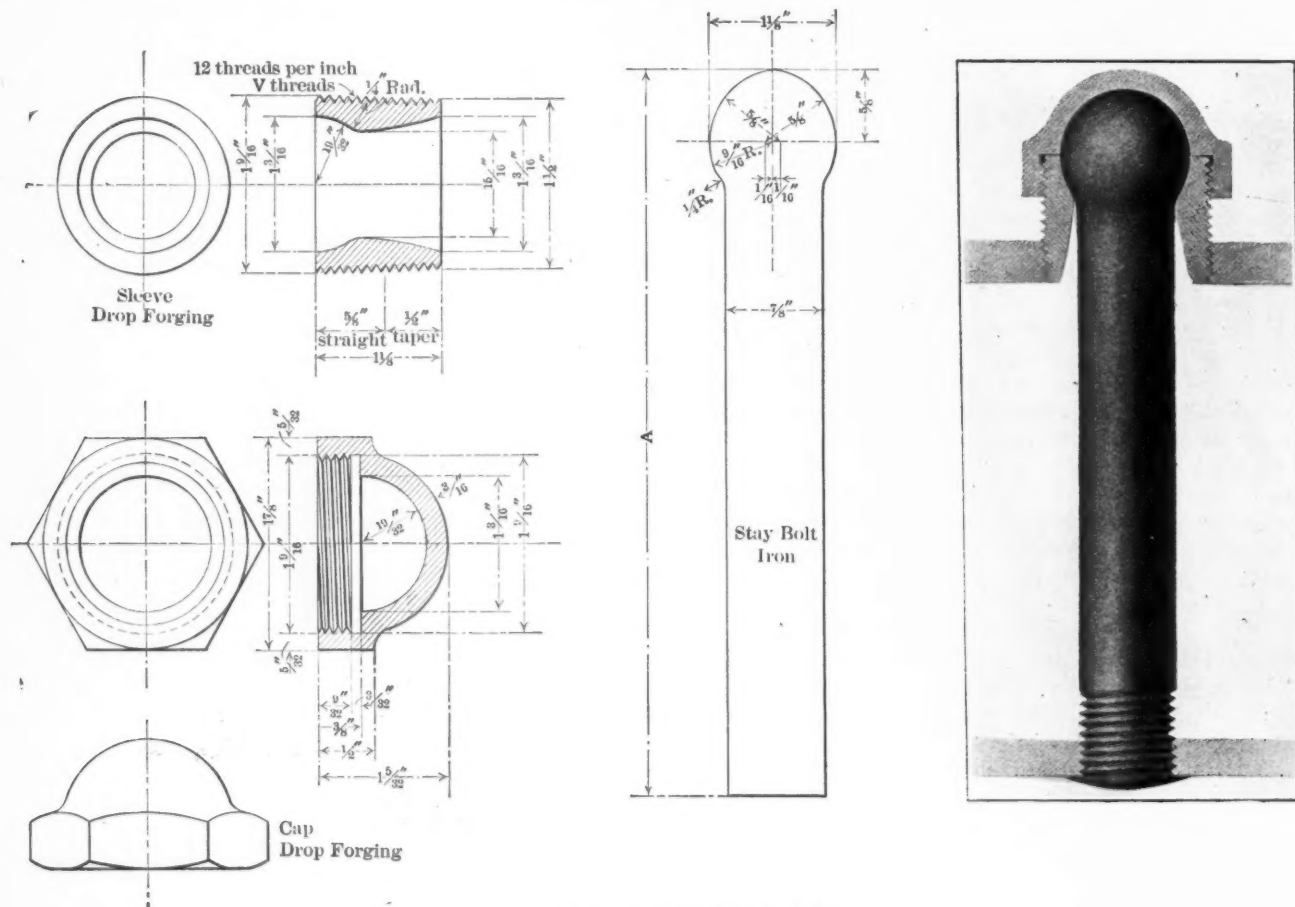
It is stated by those who have used this tool that its work is excellent and that the surface of the bushing is left in excellent condition, the metal being hardened and left smooth. This process is similar to the action of rollers in burnishing a journal of an axle in the lathe. The surface is said to be superior to that obtained by grinding because it is left hardened and smooth. The necessity for accurate work requires most exact and careful construction of the tool, and the workmanship is all that can be desired. All of the wearing parts are of hardened and ground steel. Those who are using this instrument make a special point of the fact that the machine leaves the surface of the bushing denser than before the operation of truing and that this affects further surface of the bushing favorably as to wear. Further information may be obtained from Mr. H. G. Hammett, Troy, N. Y., the manufacturer.

THE TATE FLEXIBLE STAYBOLT.

No problem in locomotive boiler practice has ever caused as much anxiety as that connected with staybolts. The difficulty has increased with increasing boiler pressures and with advancing demands made upon locomotives in service, both of these conditions being aggravated by bad water. While the introduction of wider fireboxes and wider water spaces has constituted an improvement, the motive power officials who adhere exclusively to the plain staybolt are as anxious about their boilers as they ever were. Many efforts have been made to render ordinary staybolts threaded into boiler sheets flexible enough to prevent fracture induced by the expansion and contraction of the sheets, but those most advanced in the improvement have applied bolts threaded into the inner sheet and connected to the outer sheet by flexible heads. Conversation with a number of motive power officers, who are using

ping, as flexible staybolts were applied when new sheets were put in. From this it appears that the cost of flexible staybolts for the first year's service is \$18.90 less than the same number of common staybolts. Now, if the same number of common staybolts were to break the second year, we would save \$113.40. However, since the side sheets of our engines carrying 200 lbs. of steam last but two years, flexible staybolts are renewed with the side sheets, except that the sleeves and caps are used again with the new staybolts. So far as first cost is concerned, flexible staybolts are cheaper than common staybolts when common staybolts are renewed in the round-house in lots of six at a time.

"The great advantage in the use of flexible staybolts is that the service of the engine is increased, since they do not break and engines are not held for renewals of bolts. It is our rule to take out staybolts where six adjacent staybolts are broken. The loss of service of our engines in one year under this rule, taking out 105 staybolts and renewing them, amounts to twelve days. In addition to labor and material, this period also includes the time it takes to blow off steam, letting out water and cooling off boiler, so that men can work in it; also filling up the boiler, but not getting up steam. It may be of interest to state that the greatest number of flexible staybolts we have used in one engine is 430; the least is 140. We have 27 engines equipped with these bolts—in all 5,280 flexible staybolts in use."



THE TATE FLEXIBLE STAYBOLT.

these bolts, indicates a universally favorable experience, the only thing to guard against being the construction of the head in such a way as to permit scale to form on the flexible joint and make it rigid. The construction illustrated in the accompanying engravings is presented with the belief that it will not become clogged with scale. Several years' service on one of the largest railroad systems and one on which the staybolt problem has been most systematically studied, forms the basis of this assertion.

The files of this journal for the last ten years contain what was intended to be a complete record of progress in improvement in staybolt practice. Because of its importance in connection with flexible bolts the following paragraph by Mr. T. A. Lawes, superintendent of motive power of the Chicago & Eastern Illinois Railroad, are reproduced from page 238 of our August number, 1902:

"The cost of renewing 105 staybolts, in lots of six at a time, in one year on a certain engine carrying 200 lbs. of steam was \$113.40. This includes taking down and putting up the parts of the engine which were in the way of the boilermakers; it also includes the cost of blowing off the engine, letting water out of the boiler and filling same, and cost of the water. The cost of the same number of flexible staybolts, put in all at one time, when the engine was in the shop for repairs, was \$94.50, no charge being made for strip-

It will be noted that Mr. Lawes did not include in the cost the value of the time of 12 days per year, lost on account of the staybolt renewals. Assuming the value to be \$35.00 per day, this additional item clinches his argument. Another gentleman, who has investigated the cost, places it at \$1.04 per bolt replaced, including the items mentioned by Mr. Lawes. The investigation referred to also places the life of an ordinary staybolt in the danger zone at from 10 to 12 months.

From experience up to date, it is claimed that the Tate staybolt will last the life of the firebox, and when the sheets must be renewed the cap and sleeve will be as good as new, for the application of another bolt which will be supplied at less cost than that of an ordinary staybolt. The manufacturers of the Tate staybolt state that they have never yet had one break, and that they have been applied on the Pennsylvania Railroad. They also state that after an experience in the worst districts and on engines which are exceptionally hard on staybolts, they expect the bolts to last at least seven years under such conditions.

Returning again to the comparison of cost of the ordinary rigid and the flexible staybolt, let us assume that in 10 locomotives averaging 1,000 bolts each, a road has 10,000 bolts in

service. Assuming that 10 per cent. of these, or 1,000 bolts, must be renewed every year at a cost of \$1.00 per bolt, this will cost \$1,000 per year for renewals. In seven years the cost would be \$7,000. If flexible staybolts were applied, which (supposing the sheets to be good for seven years) would cost \$600 for the service of seven years, the saving would be \$400 in the staybolts alone without including the time lost by the engines.

These engravings show that the length of the staybolt is increased by this construction. The threaded portion is only long enough to enter and be properly riveted to the inside fire-box sheet. There is no edge for the lodgement of sediment. A complete spherical socket is formed by the sleeve and cap and the sleeve is formed to give a curved flare in which the manufacturers state from actual experience that sediment does not lodge permanently. In the construction of the bolt there is no place where the material is ruptured so that corrosion is invited. A taper on the water side of the sleeve

produces a steam-tight joint and assists in throwing the load off of the threads onto the sleeve itself. In other words, instead of weakening the sheet by the number of $1\frac{1}{2}$ -in. holes for the sleeves, the space is filled with solid material. For inspection of the heads of the bolts the caps are easily removed. To install these bolts the threaded end has $1\frac{1}{4}$ ins. of additional material in order to screw the bolt into place. The sleeve is screwed in by means of a wrench on the cap, and when the bolt is sufficiently tight, a sudden reverse movement of the wrench releases the cap from the sleeve.

Further information concerning the Tate flexible staybolt may be obtained from the Flannery Bolt Company, 339 Fifth avenue, Pittsburgh, Pa. It was developed and patented by Mr. J. B. Tate, foreman boilermaker of the Pennsylvania Railroad at Altoona, Pa., and will be manufactured at the new plant of the Flannery Bolt Company, at Bridgeville, Pa. The company proposes to follow up the service of these bolts very closely through competent inspectors.

THE CLEVELAND PRESSED STEEL CARLINE.

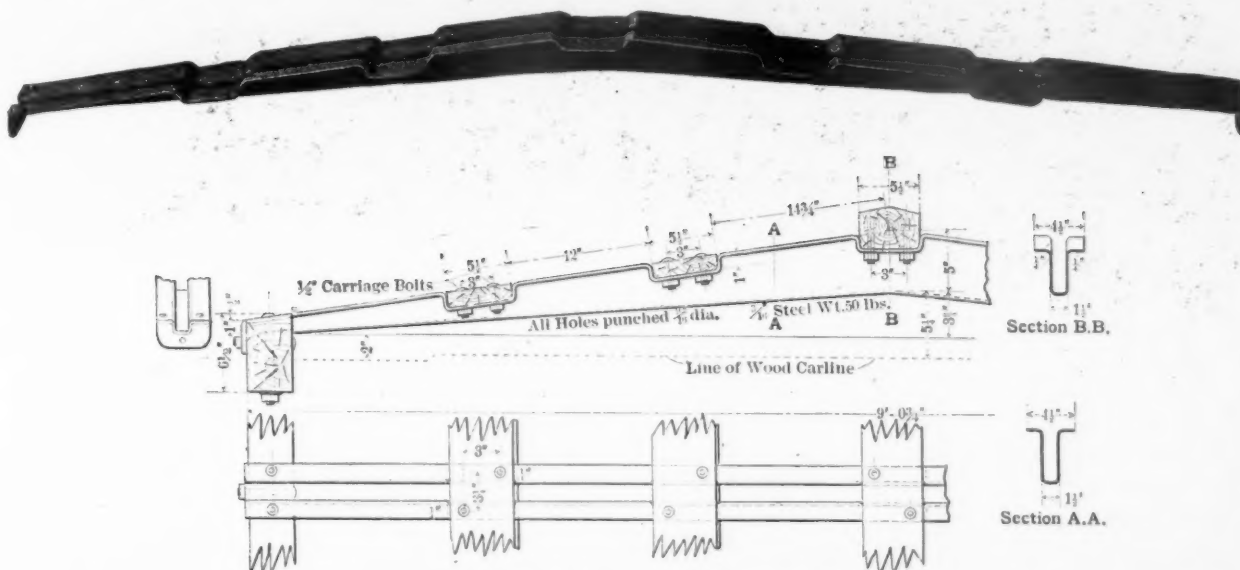
The Cleveland City Forge & Iron Company has just installed a complete plant of the latest types of heavy hydraulic and pneumatic machinery for the work of the Cleveland Car Specialty Company, recently organized to place on the market some pressed steel car specialties, and the first article ready for the market is the pressed steel carline. This carline is manufactured under the Haskell and Maltby patents now owned by the Specialty Company. There are now over 75,000 of them in service and they are constantly growing in favor.

The pressed steel carline is light in weight, pleasing in appearance, and very strong, being about $2\frac{1}{2}$ times the strength of the same weight of rolled commercial shapes. The

securely fastened by half-in. bolts which bind the side plates together, making spreading of the sides impossible. The steel carlines do not stretch, cannot shrink and are always the same distance apart. This in connection with the purlines and ridge pole being securely bolted to the carlines, results in a rigid and substantial construction that proves a sure cure for leaky roofs.

The steel carlines are indestructible, and in cases of total destruction of a car by fire or other causes, they will have a scrap value of \$2.50 to \$3 per car, and are guaranteed to last for the life of the car.

This carline is designed to be used with any style of roof, whether outside or inside metal, plastic or double board, and will increase the life of any car roof with which it may be



THE CLEVELAND PRESSED STEEL CARLINE.

use of seven carlines per car (a reduction of practically 50 per cent. over wooden carlines) at the same time gives greater strength and rigidity to the roof, and permits a saving in weight of from 250 to 300 pounds per car. The height at the eaves with the pressed steel carline is from 2 to 4 in. less, with the same inside dimension, or the cubic capacity may be increased. The cubic capacity of the American Railway Association standard car is 2,448 cubic feet, while the same car with Cleveland Pressed Steel Carline has 2,537 cubic feet.

A 38-ft. car recently built, equipped with seven steel carlines, was tested with a load of 15,000 pounds on the running board. This only caused a deflection of $\frac{3}{4}$ in. in the carline, without any permanent set when the load was removed.

The pressed steel carline passes over the side plates, having lips turned down outside of the plates, to which the carlines are

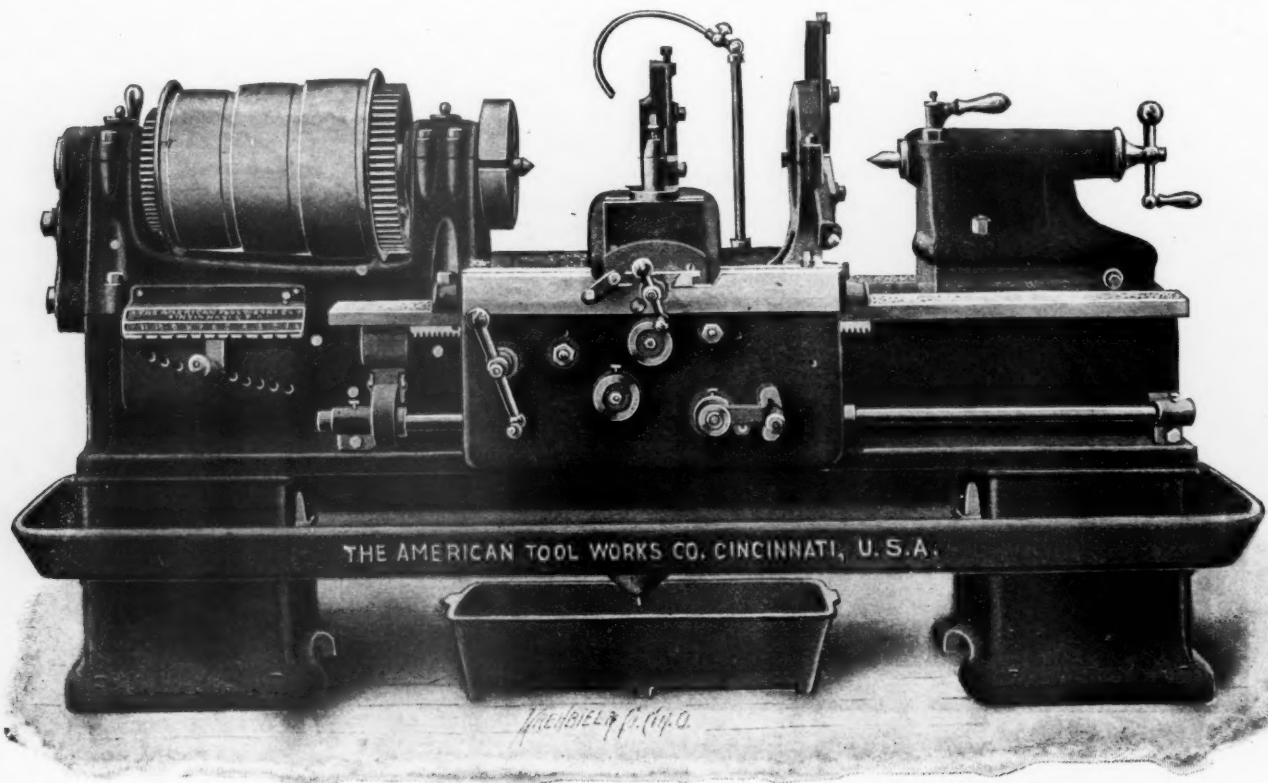
used. In cars where the under course of boards are laid lengthwise of the car, a special nailing strip is inserted in the carline.

There are two designs of pressed steel carlines, the standard U shape section, and a composite carline, being the wooden nailing strip combined with a one-half or Z section of the standard carline. The combined carline is designed particularly for use in connection with longitudinal roofing board construction. With the use of these carlines, railroads will be enabled to obtain in freight cars and stock cars the very desirable points of increased capacity, greater durability, and lighter and stronger construction without material increase in cost.

In addition to the carlines, there will soon be ready for the market a new pressed steel spring plank and other pressed steel specialties. The offices of the company are at Case avenue and Lake street, Cleveland, Ohio.

A NEW MANUFACTURING LATHE.

The accompanying engraving illustrates the very latest production of the American Tool Works Company, of Cincinnati, Ohio. This machine is their new "American" high-speed manufacturing lathe, which will be found of particular efficiency in turning up shafts of small diameters. It is given an unusual amount of strength in all its parts, in order to adapt it to the very heavy requirements which progressive manufacturers demand from a tool of this character. The bed is made extra deep and wide, and is supported by substantial cabinet legs. The apron and carriage are provided with extra strength, the apron being powerfully geared, with longitudinal and cross-feed friction. The patent drop V pattern of the bed makes it possible to place a great deal of extra metal in the bridge of the carriage, this being usually a point of weakness in a lathe. The headstock is made extremely rigid, and is equipped with a cone of three steps, all of large diameter, for a 4-in. double belt. This endows the lathe with a very great amount of belt



A NEW MANUFACTURING LATHE—AMERICAN TOOL WORKS COMPANY.

power; so much so that the contact of the belt when on the smallest step of the cone is greater than on the ordinary 36-in. lathe. As the lathe is intended primarily for working at very high spindle speeds, the bearings are of unusual size, made of phosphor bronze, and scraped to a perfect fit.

In the lathe illustrated by the accompanying illustration the entire screw-cutting mechanism is omitted because of the character of the customer's work. This mechanism, of course, can be included when desired, and is similar to that incorporated on the regular "American" lathe, with a range of forty-four changes immediately available while the machine is in full operation without removal of a single gear. The lead-screw is located on the inside of the bed, directly under the cutting tool, which thus centralizes the strain and obviates all twisting tendency, common in lathes where the screw is on the outside and pulls through the apron.

This high-speed lathe is at present built in this one size (actual swing 20 ins.); it can also be supplied, as shown, with a means of constant and effectual oil supply to the cutting tool, together with a large pan of symmetrical appearance for catching oil and chips. Further details regarding this machine, and describing recent remarkable tests performed with it, will be cheerfully furnished by the builders to those interested.

PERSONALS.

Mr. T. F. Barton, master mechanic of the Illinois Central at Paducah, Ky., has been transferred to succeed Mr. George W. Smith as master mechanic at Chicago. Mr. Barton is succeeded at Paducah by Mr. R. J. Trumbull, general foreman at the Burnside shops, Chicago.

Mr. G. W. Bynow has been appointed general foreman of the shops of the Delaware, Lackawanna & Western Railroad at Scranton, Pa., to succeed Mr. H. Shoemaker, promoted.

Mr. M. R. Coutant has resigned as master mechanic of the Erie Railroad at Susquehanna, Pa., to become master mechanic of the Ulster & Delaware Railroad, with headquarters at Rondout, N. Y.

Mr. W. E. Scott has been appointed trainmaster of the Chicago, Cincinnati & Louisville, with headquarters at Peru, Ind.

Mr. W. C. Ennis, master mechanic of the Pennsylvania division of the Delaware & Hudson, has had his jurisdiction extended over the Susquehanna division, with headquarters at Oneonta, N. Y.

Mr. Eugene M. Kann has been appointed acting general foreman of the Wabash Railroad at Delray, Mich., succeeding Mr. J. M. Barnes.

Mr. A. Stewart has been appointed mechanical superintendent of the Southern Railway to succeed Mr. S. Higgins. His headquarters will be in Washington, D. C. Mr. Stewart has heretofore held the position of general master mechanic.

Mr. F. A. Symonds has been promoted from the position of foreman of the Louisiana & Arkansas to that of master mechanic of that road, with headquarters at Stamps, Ark.

Mr. J. R. Skinner has resigned as assistant superintendent of motive power of the Delaware & Hudson at Oneonta, N. Y.

Mr. Charles Wincheck has been appointed general foreman of the shops of the Santa Fe Railway at Needles, Cal. He recently resigned as master mechanic of the Mexican Central.

Mr. W. S. Morris has resigned as mechanical superintendent of the Erie Railroad and is succeeded by Mr. George W. Willdin, recently appointed assistant mechanical superintendent.

Mr. W. Miller has been appointed master mechanic of the Terminal Railroad Association of St. Louis, with headquarters in St. Louis, Mo.

Mr. W. N. Dietrich has been appointed electrical engineer of the Canadian Pacific Railway, with headquarters at Montreal, Que.

Mr. G. A. Schmoll, superintendent of motive power of the Baltimore & Ohio at Newark, Ohio, has transferred his headquarters to Wheeling, West Virginia.

Mr. E. B. Gilbert has had his title changed from master mechanic to superintendent of motive power of the Bessemer & Lake Erie Railroad.

Mr. Alfred Lovell, assistant superintendent of motive power of the Atchison, Topeka & Santa Fe Railway, has transferred his headquarters from Topeka to Chicago.

Mr. H. L. McLow, master mechanic of the El Paso & North-eastern at Santa Rosa, Tex., has been appointed assistant superintendent of motive power of that road with headquarters at Alamogordo, N. M.

Mr. W. H. Hudson has been appointed general master mechanic of the Southern Railway, having been promoted from the position of master mechanic. His headquarters will be at Birmingham, Ala.

office of the superintendent of the Pennsylvania Railroad at Renovo, Pa. One year later he became a machinist apprentice at that point and served five years. He then entered the drafting room and was soon transferred to the drafting room at Williamsport, Pa. From that position he entered the service of the Lake Shore as chief draftsman at Cleveland, four years ago.

EXHIBIT OF PRESSED STEEL CARS.

The four cars, each of 50 tons capacity, shown in this illustration form a part of the exhibit of the Pressed Steel Car Co. at the World's Fair at St. Louis. They embody many of the best car appliances and constitute an instructive exhibit.

One of them is a Pennsylvania standard, Class G. S. A, gondola of pressed steel, 40 ft. long, and with wooden drop ends and drop doors. Its weight is 39,400 lbs. The third is a pressed steel side dump gondola, built on an entirely new design. It is 41 ft. 6 in. long and the whole bottom of the car consists of drop doors, through which the whole load can be dumped at either side of the track and the doors, when closed, give the car an entirely flat bottom. This car is specially intended for ballast, gravel and sand or other material which is dumped. It has two kinds of doors for demonstration purposes. The doors of one side are controlled by a sliding shaft and on the other side by a fixed rod, the operating gear being worked by a worm and wheel. The fourth is a box car, with structural steel underframing and steel superstructure. A portion of the siding is omitted in order to show the framing. This car weighs 40,000 lbs. and is built to the American Railway Association standard interior dimensions. In this construction the side framing assists in carrying the load. The first is an improved steel flat car with wooden floor. It



INSTRUCTIVE EXHIBIT OF PRESSED STEEL CAR CONSTRUCTION.

Mr. J. B. Kilpatrick has been appointed superintendent of motive power of the Eastern lines of the Chicago, Rock Island & Pacific, with headquarters in Chicago. He has been assistant superintendent of motive power at Chicago.

Mr. B. A. Worthington has been appointed assistant director of maintenance and operation of the "Harriman Lines," consisting of the Union Pacific, the Oregon Short Line, the Oregon Railroad & Navigation and the Southern Pacific companies. Mr. J. Kruttschnitt was recently placed in charge of operation and maintenance of these lines and will be assisted by Mr. Worthington, who has had a remarkable career, beginning as a telegraph messenger boy.

Mr. Arthur Warren has accepted the management of the publicity department of the Allis-Chalmers Company. His admirable success in developing the publicity department of the Westinghouse interests is well known and is sufficient promise for his present work. He has had a long and wonderfully successful career as a journalist and as London correspondent of the *Boston Herald*. The Allis-Chalmers Company has done wisely and well to secure his services.

Mr. R. B. Kendig has been appointed mechanical engineer of the Lake Shore & Michigan Southern Railway with headquarters in Cleveland, Ohio. The position of assistant superintendent of motive power of this road was abolished upon the resignation of Mr. H. H. Vaughan. Mr. Kendig entered railroad service at the age of 16 years, as a messenger boy in the

weighs 33,100 lbs. and is much lighter than cars of similar capacity of ordinary construction.

In addition to this equipment the Pressed Steel Car Co. are exhibiting their pressed steel mine dump car, which is a new departure in steel construction; also their pressed steel Fox tender truck frame, pressed steel body and truck bolsters, brake beams, pressed steel side stakes and center plates, together with a number of their model appliances for use in freight car construction.

ROUNDHOUSE CRANES, JACKS AND VENTILATION.

To the Editor:

My attention has been called to the article in your April issue on roundhouses, written by Mr. Soule. On page 122, in speaking of the use of cranes in roundhouses, the article reads as follows: "In this case smoke jacks cannot be used, and some form of roof ventilation must be depended on to carry off the smoke."

I wish to correct the statement by calling the attention of your readers to the fact that the Dickinson multi-telescoping smoke jack and the Dickinson interlocked overhead traveling crane fulfill these conditions exactly and are designed for this purpose.

You will soon be placed in position to describe this system fully for the benefit of your readers.

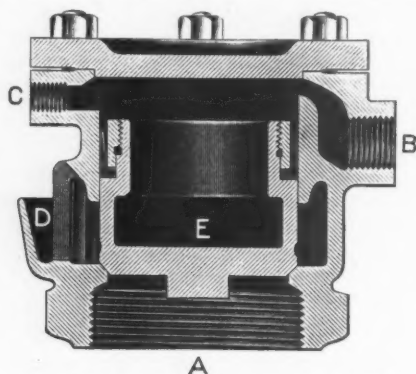
PAUL DICKINSON.

Security Building, Chicago, April 22, 1904.

BRODERICK & BASCOM RUPE COMPANY.—A new price list of power, steel and crucible steel switch ropes has been received from this company. It is being distributed among railroad officials, and copies will be sent upon application to the offices of the company, 805 North Main street, St. Louis, Mo.

CYLINDER RELIEF AND VACUUM VALVE.

This valve is made by the Star Brass Manufacturing Company, Boston, Mass. It is designed to relieve excess pressure due to water in a locomotive cylinder and also to relieve the vacuum in drifting. No springs are used, the valve being held to its seat by the steam pressure. It is held away from its seat by the vacuum created in the steam passages in drifting. The inlet A is connected to the steam port leading to the cylinder and gives a 3-in. opening. To the inlet B a $\frac{3}{4}$ -in.



CYLINDER RELIEF AND VACUUM VALVE.

pipe is connected, leading to the live steam chamber in the steam chest. The vacuum forming in the passage when the throttle is closed causes the atmospheric pressure to raise the valve and when the throttle is open the piston holds the valve E closed, unless forced open by water from the cylinder. D is a large orifice for communication with the atmosphere. The connection C is for a drain plug or cock. It should be noted that the area of the piston portion of the valve E is greater than that of the valve below it. This valve is designed specially for locomotives which are fitted with piston valves and also for compounds.

THE ALLFREE HUBBELL VALVE GEAR.

This valve gear, which is being applied to a number of locomotives, is advocated with a view of reducing cylinder condensation by reducing the radiating surfaces of steam ports, and by a special construction of the valves, cylinders and saddle which is designed to protect the steam from loss of heat in its passage to the cylinder and to maintain the cylinder continuously hotter than is possible under the usual construction. This is done to contribute toward a higher pressure of steam for the cylinders.

The valve movement itself is modified by a simple addition to the existing link motion without replacing that motion, which delays the opening of the exhaust port at all points of the cut-off. This holds the steam in the cylinders for a greater portion of each stroke and thereby increases the ratio of expansion, decreases the compression and secures more work out of a given quantity of steam than is obtained in the case of ordinary link motion. This addition to the link motion also delays the closing of the exhaust port at all points of the cut-off, thereby decreasing the compression and decreasing the negative work in the same proportion.

The cylinder clearance is reduced to about $2\frac{1}{2}$ per cent., as against about 8 per cent. in the case of ordinary 20 by 26-in. cylinders. The locomotives which are now in service having this valve motion are reported to be doing very satisfactory work. A copy of a valve motion report from a locomotive built on this principle at the Cooke works of the American Locomotive Company shows very unusual delay of the exhaust opening and exhaust closure of the valve. The engine referred to has 20 by 26-in. cylinders, and the report indicates that at full gear, $\frac{1}{2}$ stroke and $\frac{1}{4}$ stroke, the exhaust opening occurs at $25\frac{3}{4}$ in., $22\frac{3}{4}$ in., and $22\frac{1}{4}$ in., respectively. The corresponding exhaust closure occurs when the piston is $\frac{1}{2}$ in., 2 3-16 in. and 2 13-16 in. from the end of the stroke for these respective cut-offs. These figures are remarkable and entitle the valve gear to special consideration on the part of those who are interested in the locomotive.

BOOKS AND PAMPHLETS.

Niles-Bement-Pond Company. A new catalogue of machine tools has been received from this company. It is a large book of 750 pages, and is really a compendium on the practice of this concern.

This is the most complete catalogue of machine tools ever published. It opens with six full-page illustrations of the various works of the Niles-Bement-Pond Company, and following these are thirteen pages of medals and diplomas awarded the various constituent companies of this concern. These medals date as far back as 1871. The medals of the more recent expositions, however, are much in the majority. The reproductions of the medals are particularly excellent. The main part of the catalogue follows. First are the machines for railroad shop use. These include a most complete line of driving-wheel lathes. Fourteen different full-page illustrations are given of these machines, showing all sizes from 51-in. to 100-in. swing, and one or two special machines adapted particularly to the use of modern high power tool steels. The other railroad tools include three different styles of car-wheel lathes, a large variety of axle lathes, cutting-off and centering machines, quartering machines, car-wheel borers and hydrostatic wheel presses. The next division of the catalogue is devoted to lathes, including all sizes from the Pratt & Whitney bench lathe to the massive Bement 125-in. crank shaft lathe. The variety of heavy lathes shown is especially complete. Besides the standard lathes, a number of special lathes, including pulley lathes, turret lathes and automatic screw machines are shown. Fifty pages are devoted to planing machines, and a specially large variety of heavy planers are shown. Various methods of driving by magnetic clutches and motors mounted on the top of housings are illustrated. The large portable rotary planers are among the most interesting machines described in this section of the catalogue. These machines are self-contained, the motor being mounted on the saddles. The largest has a swing of 120 ins. and is arranged so that it can be lifted by a crane and placed in any position on a floor plate. Slotting machines and milling machines take a large number of pages; several very handsome full page illustrations being devoted to work done on the Pratt & Whitney thread milling machines. A large number of heavy drills are shown, including vertical drills, radial drills and multiple drills. Among the most interesting pages in the catalogue are those devoted to boring machines. First are the horizontal boring machines which include all varieties of boring machines in which the work remains stationary the cutting being done by revolving cutters. A particularly complete line of floor boring machines or horizontal boring, drilling and milling machines are shown, including every conceivable variety of these machines. Fifty pages are devoted to boring and turning mills. Here again, the large mills are most interesting, but more space has been devoted to describing the smaller machines. The 16-ft. and 20-ft. mills are particularly massive. Following the section on boring and turning mills are a few pages devoted to miscellaneous machine tools, and then comes a very complete line of boiler shop machinery, including plate planers, bending rolls, punching and shearing machines, hydraulic presses, steam and hydraulic riveters. In the latter part of the catalogue the full line of Bement steam hammers is illustrated, together with a number of installations of Niles electric traveling cranes. The last pages are devoted to the small tools made by Pratt & Whitney Company. In the arrangement of the catalogue, particular care has been taken to put the various machines in their logical order, so that any machine can be found without reference either to the table of contents in the front of the book or the complete index at the back. Metric as well as English dimensions are given throughout and code-words are placed under each machine. The whole catalogue is a particularly good piece of press work, the cuts coming out with great sharpness and clearness. Some idea of the size of the book can be obtained from the fact that it weighs about 50 pounds, the entire edition amounting to 75 tons of catalogues. While the catalogue is not intended for general distribution it will be gladly sent to users of heavy machine tools.

Manual of American Street Railways. Reprinted from Poor's Manual of Railroads for 1903. Published by Poor's Railroad Manual Company, 68 William street, New York, January, 1904.

This is a reprint in pamphlet form of the statistics of city and suburban electric and other surface and elevated railways which have appeared in the thirty-sixth annual volume of Poor's Manual. It also contains a summary of street-railway mileage, equipment and capitalization.

ST. LOUIS EXPOSITION.—A very accurate idea of the great exposition soon to be opened at St. Louis is given in an attractive booklet of 40 pages, with fine engravings and an excellent map of the grounds, which has been prepared for distribution by the Boston & Maine Railroad. It will be mailed free on application to Mr. D. J. Flanders, general passenger and ticket agent of this road, Boston, Mass.

JEFFREY MACHINERY.—In a little pamphlet of 28 pages designated as "Circular No. 73," the Jeffrey Manufacturing Company of Columbus, Ohio, furnishes a summary of its specialties in conveying machinery for every kind of service on railroads, in mines, manufacturing establishments and in engineering construction work. Each special application is illustrated from photographs of actual construction and the catalogues in which detailed information is given are referred to by numbers.

PNEUMATIC HOISTS.—A catalogue of pneumatic hoists has been received from the Chicago Pneumatic Tool Company. In 32 pages it illustrates and describes pneumatic hoist motors, general hoists, data for hoists, general hoists and trolleys combined, stationary winding drums, cylinder air hoists, telescopic air hoists, air cranes and elevators. The pamphlet is designated as their special hoist catalogue. It is printed on fine white coated enamel paper and it presents all the information, including consumption of air, which a purchaser needs for ordering these labor-saving devices.

ELECTRIC COAL MINING PLANT.—In their Bulletin No. 4, the Jeffrey Manufacturing Company, Columbus, Ohio, present a well-written paper, by Mr. Sanford B. Belden, showing the enormous returns which are obtained upon investments in electric coal mining equipment. This pamphlet gives what people want to know, the facts upon which to base the appropriation of money for the introduction of improved machinery and methods. It also presents approximate costs. This is the highest type of literature of this character.

RAILWAY MOTIVE-POWER EXPENSES.—Under this title the Falls Hollow Staybolt Company have issued a pamphlet containing quotations from prominent motive-power officials and observations on the staybolt problem from the pen of Mr. John Livingstone, of Montreal. This little pamphlet presents in convenient form a lot of information concerning staybolts which should be brought to the attention of every motive-power official in the country. Copies will be furnished on application to the Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio.

"THREE SCORE YEARS AND TEN. A RECORD OF STEADY GROWTH."—This is the title of a beautifully arranged pamphlet that has recently been issued by the Fairbanks Company, commemorating the seventieth birthday of the company and also presenting an interesting general survey of the magnitude of its business. Ten branch houses in the United States are illustrated and five in Canada and England. No better idea can be gained of the extent of the business of the Fairbanks Company than by glancing through this pamphlet.

WESTINGHOUSE-PARSONS STEAM TURBINE.—A new, comprehensive and exceedingly interesting catalogue of these steam turbines has been distributed by the Westinghouse Company's Publishing Department. It illustrates the construction and installation of these turbines, and in well-written chapters presents the history, development, commercial features, records of tests, and statements of advantages of these remarkable power producers. Among the engravings is a striking comparison of the size of 5,000-kw. direct-connected generating units of the reciprocating and turbine types.

SOMETHING PNEUMATIC.—Is the title of a monthly magazine, published by the Chicago Pneumatic Tool Company. It is devoted to the interests of pneumatic appliances and their motive power. The April number contains descriptive articles on the Redfield pneumatic saw, a new design of single stage air compressor, the use of pneumatic hammers in boiler work, in stone working establishments, the long-stroke hammer in gold mining, and several convenient foundry tools. This magazine will be forwarded gratuitously to anyone interested in the field which it covers. Address, Chicago Pneumatic Tool Company, Fisher building, Chicago, Ill.

DRIVING CHAINS.—The Joseph Dixon Crucible Company, Jersey City, N. J., have issued a leaflet on the subject of the proper care of driving chains. This concerns the lubrication of chains with a special compound manufactured by them, which experience has proven to be more satisfactory for this purpose than any other they have used. The leaflet also states the importance of keeping driving chains clean. In view of the fact that chain driving is now becoming quite general in connection with motor-driven machine tools, this subject will interest many of our readers.

STORAGE BATTERY INDUSTRIAL LOCOMOTIVES.—In their new Bulletin No. 5, the Jeffrey Manufacturing Company present the advantages of storage battery locomotives for working about the yards and buildings of industrial establishments. It illustrates some of the different types of equipment for this purpose which has become a necessity in large plants. The flexibility of this form of locomotive renders it specially adapted to this purpose and there is no fire risk in using these locomotives in and around buildings. The pamphlet includes extracts from a paper read by Mr. F. L. Sessions, before the American Institute of Electrical Engineers. It is the best presentation of the subject available anywhere.

AMERICAN SHEET & TIN PLATE COMPANY.—Two artistic booklets have been issued by the American Sheet Steel and the American Tin Plate companies. These contain a brief history of iron and its application to roofing; instructions, "How to Construct a Tin Roof," and a large amount of tabulated technical information concerning black and galvanized iron and steel sheets, roofing tin and similar products for use of builders. These will be sent upon application to Mr. W. C. Cronmeyer, advertising agent of the American Sheet & Tin Plate Company, Pittsburgh, Pa.

THE ICE IS OUT.—Fishing in the streams of Maine has begun, and sportsmen are beginning to plan their trips to the beautiful regions of Maine, which offer so much for them. In New Hampshire, Lakes Winnepesaukee and Sunapee and Newfound Lake take the lead; but there are hundreds of smaller ponds and lakes, and numerous trout brooks besides. Vermont has Chaplain, Memphremagog and Willoughby, all prolific haunts; while away over the border line in Quebec, New Brunswick and Nova Scotia are many famous resorts. For 2 cents in stamps the Boston & Maine Passenger Department, Boston, will send their illustrated booklet, "Fishing and Hunting," which describes the fishing and gaming section of northern New England and Canada; also another booklet, invaluable to the sportsman, with the fish and game laws for 1904 of Maine, New Hampshire, Vermont, Massachusetts, Quebec, Nova Scotia, New Brunswick and Newfoundland.

CRANDALL PACKINGS.—Is the title of a 54-page pamphlet describing and illustrating the various kinds of packings manufactured for steam, ammonia and hydraulic machinery by the Crandall Packing Company, Palmyra, New York. This company has, in its experience of 20 years, developed a large line of packings using rubber and its various compositions. The descriptions include expansion, sectional ring, spiral, high pressure ring, high pressure coil, marine, valve rod and hydraulic packing for a variety of services. They also include special steam hammer ring packing for all forms of rods and many other special kinds. Our readers will be particularly interested in the air pump and throttle stem packing, which is manufactured especially for packing locomotive air pumps and throttles. It is furnished in sets for the steam and air ends of pumps and is made to perfectly fit the rods and boxes, the number of rings being just sufficient to fit the pumps without cutting. This packing has been adopted by many of the leading railroads. The pamphlet describes sheet and other packing, the line being complete for the purposes mentioned. The company has offices at 123 Liberty street, New York, and 30 La Salle street, Chicago.

THE SAFETY CAR HEATING AND LIGHTING COMPANY.—This company has recently issued a new edition of its map of the United States, showing the locations of Pintsch gas plants and the railroads using the gas in the various States. The centers for gas supply are practically all the large railroad centers of the country. Accompanying this is a small pamphlet containing a directory of Pintsch plants, giving the name and address of the one in charge of the plant. In case a car leaves any point with an insufficient supply of gas or with equipment which requires attention, the next works on the route may be notified by wire and proper attention may be given. This indicates the systematic methods of this company.

A list showing the progress of the Pintsch equipment up to the end of last year indicates that there are now 80 gas plants in the United States, 75 in Germany, 87 in England and a total of 372 plants all over the world. The list also shows that Germany has 45,200 cars lighted with this gas; England, 21,100; the United States, 22,243 and that the total number all over the world is 128,881 cars. In Germany 5,583 locomotives are so lighted. The number of Pintsch gas buoys and beacons is 1,426. This form of help to harbor and river navigation is recognized as indispensable. Another recent publication of this company, "Directions for Management and Catechism of Steam Heating Apparatus on Trains" is also worthy of note. It is a little book of pocket size containing in concise form directions for the management of steam heating apparatus of trains, making up trains, regulation of temperature and changing of engines. In the catechism proper are questions and answers relative to the description of the apparatus, operation and care of it and responsibility of employees. The catechism constitutes a much-needed innovation for the proper education of employees, the use of which will contribute greatly to the proper use of the apparatus and therefore to the comfort of travelers. The equipment statement already referred to includes 2,209 cars equipped with Pintsch light and 2,964 cars equipped by this company with steam heat last year. In connection with the introduction of 2-in. train pipes in place of 1½-in. these people have developed their coupler No. 920-A, which is furnished with 1½ or 1¼-in. gaskets, as desired. This coupler has straight ports and a substantial and simple locking device.

NOTES.

Mr. John L. Weeks, treasurer and general manager of the American Steam Gauge and Valve Manufacturing Company, died April 2. He had been connected with this company for over thirteen years, and he will be greatly missed in the company and by a large circle of friends.

The Walter A. Zelnicker Supply Company, of St. Louis, have just received a large order for their double-clutch car movers from a large export company of New York for shipment to foreign countries.

BALDWIN LOCOMOTIVE WORKS.—The Chicago offices of the Baldwin Locomotive Works and the Standard Steel Works have been moved to rooms 623 and 625 Railway Exchange Building, Chicago.

CORRINGTON AIR BRAKE.—The new Cole four-cylinder balanced compound locomotive built by the American Locomotive Company for the New York Central Railroad, and illustrated in this issue, is equipped with the Corrington consolidated engineer's valve.

THE DERRY-COLLARD BOOK CLUB.—A new plan for selling books on the installment basis has been arranged by the Derry-Collard Company, 256 Broadway, New York. Those who are interested in a convenient method of securing technical books with easy payments should send for a copy of the circular describing the plan.

The Canadian Westinghouse Company, Limited, of Hamilton, Canada, have recently engaged Mr. C. C. Starr, who was formerly connected with the firm of John Starr, Son & Company, to act as their representative in the Maritime Provinces, with headquarters at 134 Granville street, Halifax, N. S.

THE T. H. SYMINGTON COMPANY.—April 1 this company made a change in its sales department in the Chicago territory, which has been handled by their agents, the Railway Appliances Company. The T. H. Symington Company now has its own office in room 315, Railway Exchange, Chicago, which is under the charge of Mr. E. H. Symington, general Western sales agent.

CROCKER-WHEELER CO.—These manufacturers of electric generators and motors will on May 10 open a branch office in theibernia Bank building, New Orleans. Mr. W. P. Field, of the St. Louis office of the company, will be the representative in charge. Although there are fifteen Crocker-Wheeler branches, from Boston to San Francisco, including St. Louis and Atlanta, this new office has been made necessary, to accommodate the steadily increasing market for electric machinery in the South and Southwest.

KENNICOTT WATER SOFTENER COMPANY.—This company has moved into its new quarters in room 525, 527 and 529, in the new Railway Exchange building, corner Jackson and Michigan Boulevard, Chicago. This magnificent new office building brings together a large number of railroad offices and headquarters of concerns closely associated with railroad business in Chicago.

THE MAMOLITH CARBON PAINT COMPANY.—This company has increased its capital stock to \$200,000 for the purchase of the plant of the Iridian Paint Company and has moved its offices in Cincinnati from the Johnston building to the building formerly occupied by the Iridian Paint Company. Mr. A. B. Burtis, manager of the Mamolith Carbon Paint Company, states that extensive improvements are to be made.

AUBURN BALL-BEARING COMPANY.—This company has removed its main office and works from Auburn to 18 Commercial street, Rochester, N. Y., where greatly improved and extended facilities are available to take care of their increasing business. They manufacture ball bearings of all kinds, ball thrust washers, propeller bearings, aligning, step and pedestal bearings, and a large number of transmission specialties. Mr. Mark D. Knowlton is president, Mr. Henry La Casse vice-president, and Mr. Frederick Kirk Knowlton secretary.

CROCKER-WHEELER CO.—This company has doubled its capital stock, which is now \$2,000,000. The company has had a remarkable career, and those who are acquainted with its history will not be surprised to learn that its growth has required this increase of capital. It was organized in 1882 by Dr. Schuyler S. Wheeler and Prof. Francis B. Crocker, with a comparatively modest beginning. After vigorous and rapid growth it now has fifteen branch offices from Boston to San Francisco, and does a very large business in electrical power apparatus. The capitalization was several times increased until in 1899 it had become \$1,000,000. Its rapidly extended business has made it necessary to double this amount.

THE ALLIS-CHALMERS CO., MILWAUKEE, WIS.—This company has recently greatly extended its business by taking up the building of gas engines, steam turbines, hydraulic and electrical machinery, in addition to the class of output for which its several works have for many years been well known, viz.: the construction of reciprocating engines; pumping, rolling-mill and blowing engines; flour-mill, saw-mill, rock-crushing and cement machinery; also machinery for manufacturing perforated metals. An additional department of publicity has just been organized, with Mr. Arthur Warren as manager. This department has its headquarters at the offices of the company in Milwaukee, Wis.

B. F. STURTEVANT CO.'S NEW PLANT.—Since the removal of the foundry and pattern departments from the old plant at Jamaica Plain to the extensive new quarters at Hyde Park the moving of the other departments has progressed satisfactorily. The fan, heater and electrical departments have already been installed, and the machine-shop equipment is well advanced. All the machinery in the plant will be of the most modern and approved types, and complete systems of cranes and industrial railways will contribute to accurate, rapid work at a minimum cost. In the handsome office building the publication department is generously provided for, and its equipment includes a pressroom and storage space for paper stock and printed matter. This company has for several years maintained a printing plant of its own, and is now handling all of this work itself excepting engraving.

ALLIS-CHALMERS CO.—Mr. Ervin Dryer has resigned his position with the Westinghouse Electric and Manufacturing Company and has accepted an appointment with the Allis-Chalmers Company. Mr. Dryer's connection with the Westinghouse Company extended over a period of sixteen years. He is one of the most competent salesmen in the electrical and mechanical field, and his wide acquaintance throughout the Western part of the United States will be of great service to the Allis-Chalmers Co. in the extensive new developments which they have undertaken. Mr. Dryer has already entered upon his new duties with the Allis-Chalmers Co., and his headquarters will be at their offices in the New York Life building, Chicago. He will give his attention to their engine work, as well as to the sale of Bullock electrical apparatus, which the Allis-Chalmers Co. now control through their acquisition of the Bullock Electrical Manufacturing Company, of Cincinnati.